APR 8 - 1946

ENGINEERING NEWS-RECORD

APRIL 4, 1946

New loose-rock section added at the downstream toe of Saluda Dam to increase the stability of the structure

In This Issue UNDERWATER CUTTING AND WELDING BY SIMPLIFIED PROCESSES • SEWAGE FILTERS CAN TAKE A DOUBLE LOAD • CLOSING LEVEE BREAKS UNDER TIDAL CONDITIONS • IMPROVEMENTS MADE AT SALUDA DAM • THE HIGHWAY CONTRACT SITUATION

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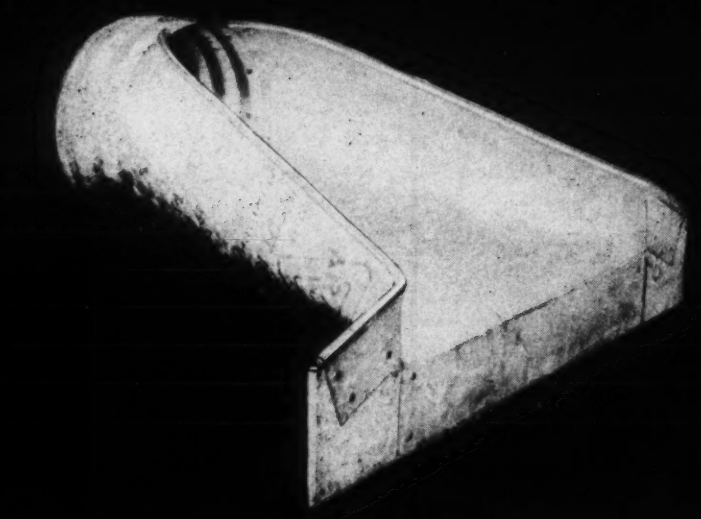

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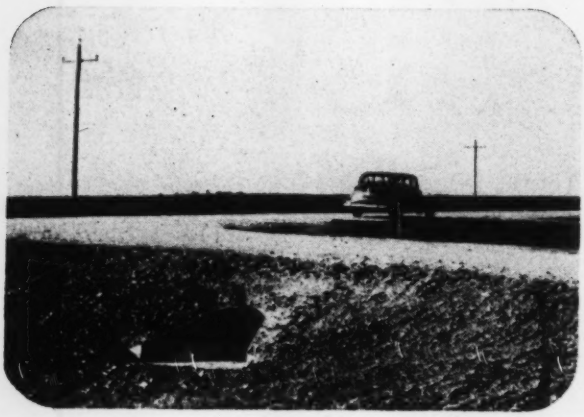

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Volume 136 • Number 14

APRIL 4, 1946

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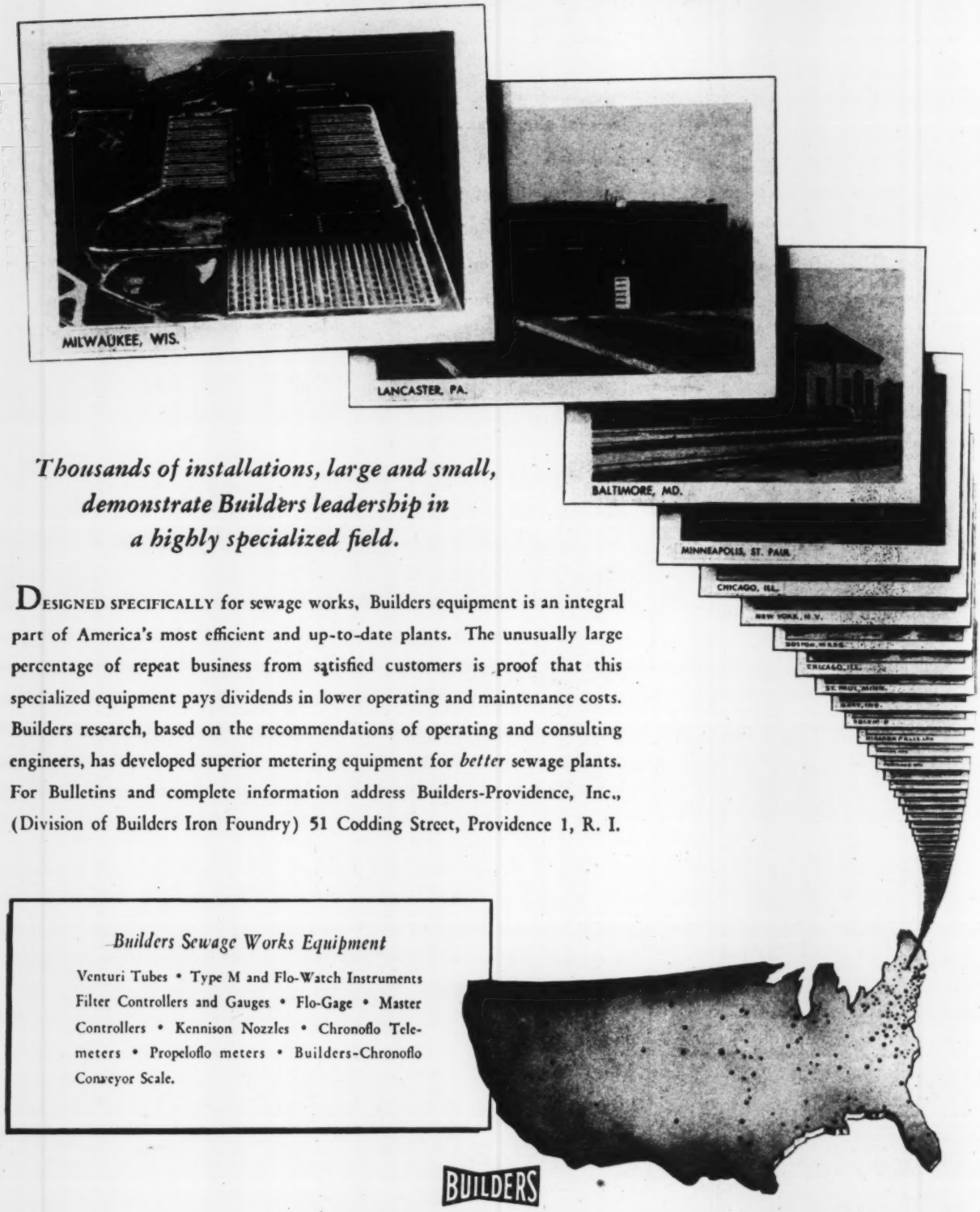

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Construction Trends

Sewerage Construction Proposed Tops $1,624,237,000

The cumulative total of proposed sewer and sewage construction on record with *Engineering News-Record* through February, 1946 totals $1,624,237,000. This is the equivalent of 10 years' construction at the highest prewar rate of $160,000,000 in 1939.

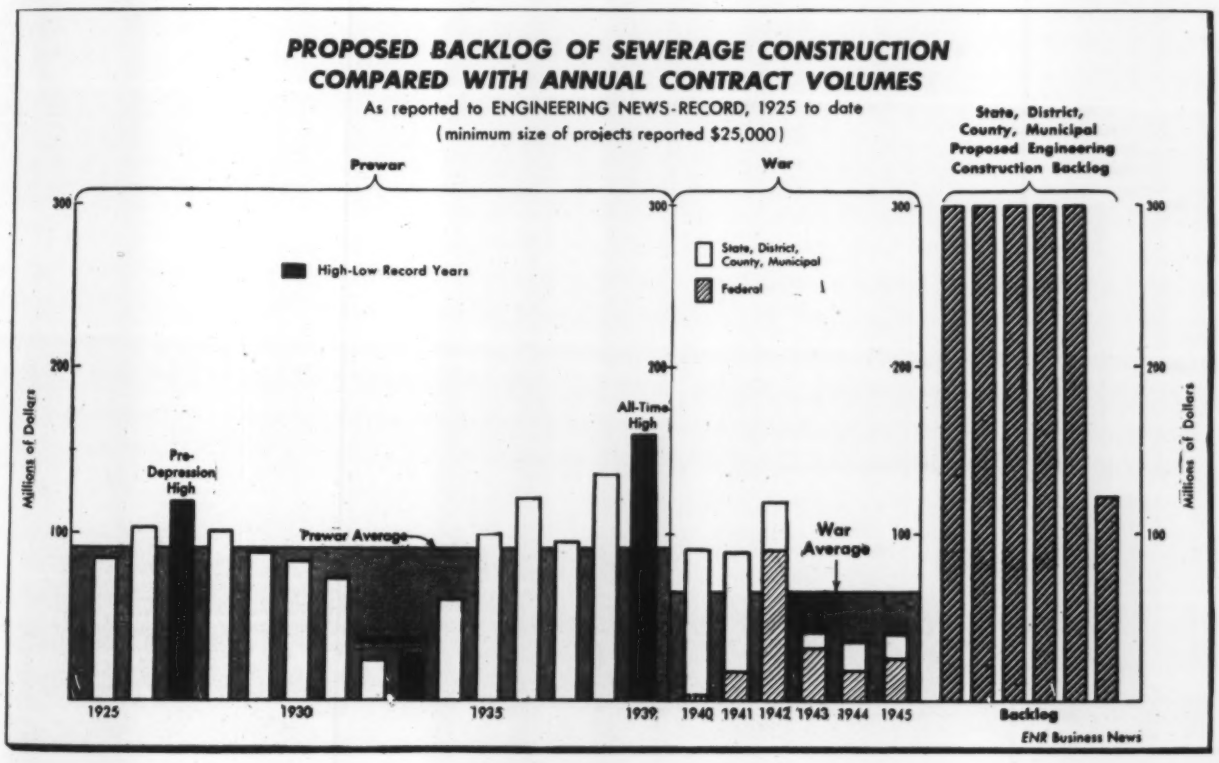
The war-year average for new construction of sewers and sewage disposal facilities was $67,600,000 of which a large percentage was federal construction. The prewar average was $91,440,000.

In spite of this large backlog of proposed sewerage construction only $5,660,000 was put under contract in January and February of this year. And of this contract volume only $2,183,000 came out of the backlog, the rest went into construction volume direct without having been first reported as "proposed". This indicates that the backlog total is conservative.

It is conservative in another respect, too. Many on the projects making up this $1,624,000,000 total are entered at cost estimates based on 1940 prices and wage rates. Rising costs of construction will require new budgets. The *Engineering News-Record* construction cost index averaged 242 in 1940. In April, 1946 was up to 335. This means that 1946 construction dollars will buy only 72 percent as much construction as the 1940 dollars would produce. Or assuming that the entire proposed sewerage backlog were based on 1940 costs, the same amount of work would cost $2,241,000,000 at today's material prices and wage rates.

The new restrictions on commercial and industrial building, designed to speed up the housing program, do not affect sewers or sewage treatment. Actually the speedup in housing should accelerate sewerage, necessitating extensions and new lines to provide for the new connections and newly developed areas, and new treatment plants to relieve overloaded systems.

States which have the largest backlogs of proposed sewer and sewage treatment construction on record, at recorded cost estimates, are: New York, $269,229,000; Illinois, $177,781,000; Pennsylvania, $151,864,000; Michigan, $128,625,000; California, $125,996,000; Ohio, $115,175,000; Texas, $68,852; Massachusetts, $61,264,000; New Jersey, $61,522,000; Indiana, $49,870,000; Florida, $46,122,000; Missouri, $31,455,000; Washington, $30,452,000; Tennessee, $28,699,000; Connecticut, $26,661,000; Wisconsin, $24,430,000.



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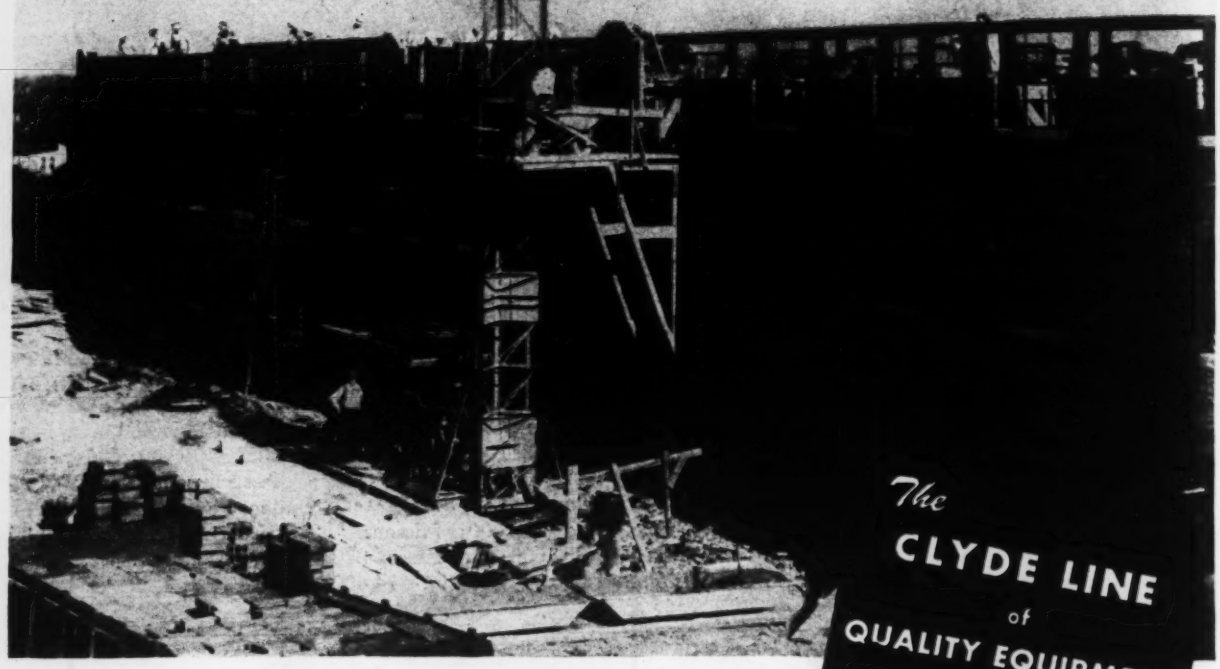

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New Construction in March

Total volume for month is $383,981,000, highest weekly average since November, 1942. Private, State and Municipal and Federal construction all gain over previous month. First quarter total $980,283,000, shows 158 percent gain over 1945, 23 percent for public work, 475 percent gain over 1945 first quarter for private construction.

Civil engineering construction volume in the continental United States totals $383,981,000 for March, an average of $95,995,000 for each of the four weeks of the month. This is the highest weekly average since November, 1942 and 27 percent higher than the average week to-date in 1946 through March. It is 55 percent above the February average in 1946 and 163 percent higher than the March 1945 weekly average.

Private construction for March on a weekly average basis is $61,824,000, the highest private volume since March, 1930. It is a gain of 46 percent over February 1946 and 488 percent over March 1945.

Public construction in March on a weekly average basis is $34,171,000, the highest since August, 1944. It is 72 percent above February, 1946 and 31 percent higher than March 1945.

State and municipal construction on a weekly average basis is $23,351,000, 76 percent higher than February, 1946 and 690 percent higher than March, 1945.

Federal construction, $10,820,000 average per week is 63 percent higher than February, 1946 but 53 percent below March, 1945.

March 1946, weekly averages in the various classes of construction compared with last month reveal gains in waterworks, 303 percent; earthwork, irrigation and drainage, 260 percent; commercial buildings, 113 percent; sewerage, 103 percent; public unclassified, 71 percent; streets and roads, 62 percent; public bridges, 33 percent. Losses from February are in public buildings, 29 percent; and private unclassified, 48 percent.

Geographically, all sections except Middle West recorded gains on a weekly average basis in March over February. Middle West dropped 14 percent from its high February volume, New England gained 6 percent; Middle Atlantic, 134 percent; South, 34 percent; West of Mississippi, 25 percent and Far West, 121 percent.

All sections recorded strong gains in March 1946 over March 1945 as follows: New England, 214 percent; Middle Atlantic, 391 percent; West of Mississippi, 65 percent; Far West, 274 percent; South 37 percent.

For the first quarter, engineering construction reported by *Engineering News-Record* totals $980,283,000, a 158 percent gain over 1945 of which $326,893,000, is public, a 23 percent gain in spite of the fact that federal construction has dropped 52 percent from its 1945 rate. Private engineering construction for the quarter is $653,390,000, a 475 percent gain over 1945.

By classes of construction, the first quarter shows gains in waterworks, 191 percent; sewerage, 48 percent; public bridges, 354 percent; earthwork waterways, 719 percent; streets and roads, 419 percent; industrial buildings, 212 percent; commercial buildings, 1587 percent and unclassified private construction, 369 percent over 1945.

Geographically, New England engineering construction is up 530 percent in the first quarter over 1945; Middle Atlantic, 275 percent; South, 48 percent; Middle West, 193 percent; West of Mississippi, 90 percent; Far West, 191 percent.

New capital for construction purposes for the four weeks of March, 1945 totals $55,565,000, or a weekly average of $18,891,000 that is 91 percent above the average for February 1946 and 78 percent below the average for March 1946.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD—MARCH, 1946

Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs — waterworks, excavation, drainage and irrigation,* $15,000 *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Four Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States March 1946	United States Three Months 1946	United States Three Months 1945	Canada
Public Works										
Waterworks	520	14,338	239	1,202	583	484	17,366	26,968	9,268	259
Sewerage	43	292	465	1,249	3,328	1,119	6,496	12,156	8,223	1,539
Bridges, public	.....	2,275	1,912	446	1,695	1,747	8,075	23,289	5,128	254
Earthwork and waterways	.....	381	7,510	3,428	14,639	6,798	32,756	69,665	8,508	131
Streets and roads	278	7,551	18,672	815	12,147	7,459	46,922	111,830	21,575	1,670
Buildings, public	871	1,949	207	1,525	3,877	7,404	15,833	60,749	167,396	3,176
Unclassified, public	180	4,101	309	487	578	3,581	9,236	22,236	46,665	163
Total public	1,892	30,887	29,314	9,152	36,847	28,592	136,684	326,893	266,763	7,192
Federal government (included in above classifications)	394	1,858	7,382	3,102	16,777	13,766	43,279	109,925	227,323	.....
Private										
Bridges, private	.....	.....	.....	35	.....	.....	35	1,100	2,500	.....
Industrial buildings	3,110	16,793	5,277	15,356	19,151	13,647	73,334	253,911	81,427	6,686
Commercial buildings	13,974	52,494	2,217	13,046	21,009	61,930	164,670	360,050	21,340	3,384
Unclassified, private	1,450	360	790	877	4,668	1,113	9,258	38,329	8,177	.....
Total private	18,534	69,647	8,284	29,314	44,828	76,690	247,297	653,390	113,444	10,070
Total Engineering Construction:										
March, 1946 — 4 weeks	20,426	100,534	37,598	38,466	81,675	105,282	383,981	.....	.....	17,262
February, 1946 — 4 weeks	19,255	42,973	28,079	44,515	65,131	48,072	248,025	.....	.....	29,789
March, 1945 — 5 weeks	8,115	25,533	34,404	17,056	61,882	35,498	182,498	.....	.....	12,542
Three Months — 1946	76,771	207,415	108,140	119,724	208,726	259,507	.....	980,283	.....	71,314
Three Months — 1945	12,180	55,226	72,926	40,864	109,812	89,199	.....	.....	380,207	20,248

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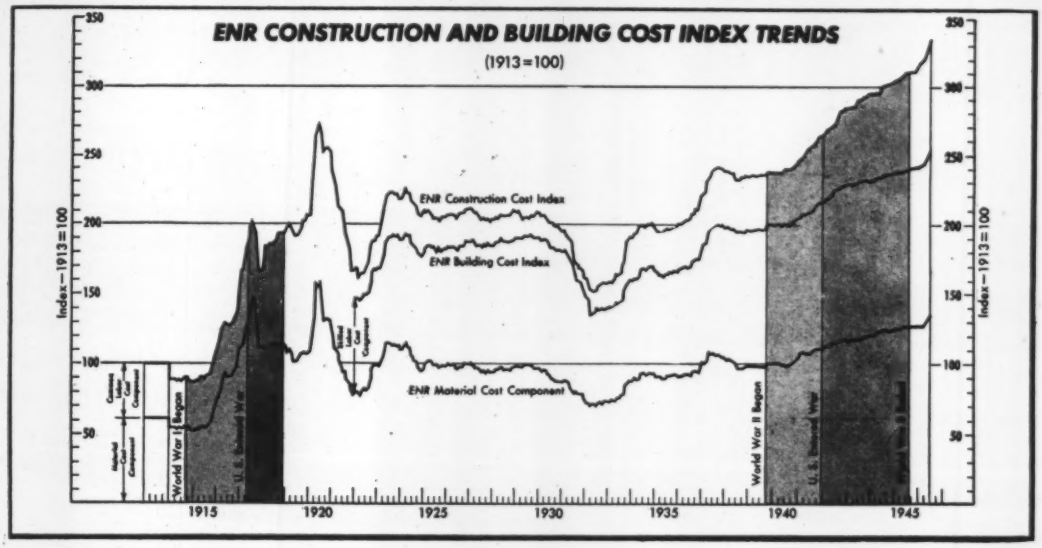
APRIL CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

(,000 omitted)	March 1945 (5 wk.)	March 1946 (4 wk.)	% Change	Three Months 1945 (13 wk.)	Three Months 1946 (13 kw.)	% Change
Total U. S. Construction	$182,498	$383,981	+110	$380,207	$980,283	+158
Private Construction	52,508	247,297	+374	113,444	653,390	+476
Public Construction	129,990	136,684	+5	266,763	326,893	+22
Federal	115,207	43,279	−63	227,323	109,925	−52
Total New Productive Capital	$53,063	$55,565	+4.7	$249,535	$357,218	+43.2
Private Investment	39,263	55,565	+41.5	158,598	198,898	+25.4
Federal (non-federal work)	13,800	.....	.....	13,800	.....	.....
Federal (federal work)	.....	.....	.....	77,137	158,320	+105.3
E N R Construction Volume Index 1913 = 100	103	256	+149	81*	204*	+152

*Three-month average.

ENR INDEX NUMBER

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Apr., 1946	334.59	160.83	254.37	137.50	.....	.....
Mar., 1946	323.83	155.66	245.41	132.66	256	112
Feb., 1946	319.52	153.59	243.94	131.86	167	73
Jan., 1946	316.32	152.05	242.23	130.94	189	83
Dec., 1945	313.48	150.69	240.82	130.18	163	71
Nov., 1945	309.28	148.67	240.55	130.00	173	76
Oct., 1945	309.28	148.67	240.35	129.93	167	73
Sept., 1945	309.28	148.67	240.07	129.77	164	72
Aug., 1945	309.08	148.57	239.94	129.70	119	52
July, 1945	308.99	148.53	239.64	129.54	119	52
June, 1945	308.99	148.53	239.37	129.40	133	58
May, 1945	307.43	147.78	238.46	128.90	93	41
April, 1945	306.43	147.30	238.46	128.90	99	43
Mar., 1945	304.50	146.37	237.85	128.57	103	45
1945 (Av.)	307.74	147.93	239.14	129.27	123	54
1944 (Av.)	298.63	143.39	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77
1942 (Av.)	276.31	132.82	222.39	120.22	553	243

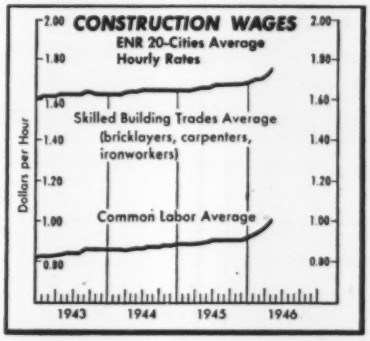
CONSTRUCTION COSTS . . . . WAGE RATES . . . . MATERIAL PRICES

	April 1945	April 1946	% Change	Change March to April 1945 Mar.	1945 Apr.	1945 %	1946 Mar.	1946 Apr.	1946 %
E N R Construction Cost Index, 1913 = 100	306.43	334.59	+9.2	304.50	306.43	+0.6	323.83	334.59	+3.3
E N R Building Cost Index, 1913 = 100†	238.46	254.37	+6.7	237.85	238.46	+0.3	245.41	254.37	+3.6

†*Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$10.904	$1.004	+11.1	$0.895	$0.904	+1.0	$0.988	$1.004	+1.6
Skilled labor (Av. 3 Trades)	1.650	1.762	+6.8	1,643	1.650	+0.4	1,743	1.762	+1.1
Bricklayers	1.747	1.881	+7.7	1.744	1.747	+0.2	1.839	1.881	+2.3
Structural Ironworkers	1.704	1.786	+4.8	1.698	1.704	+0.4	1.771	1.786	+0.8
Carpenters	1.498	1.620	+8.2	1.487	1.498	+0.7	1.618	1.620	+0.1
Cement, per barrel	2.74	2.77	+1.1	2.74	2.74	0	2.74	2.77	+1.1
Reinforcing Steel, cwt	2.79	3.015	+8.1	2.79	2.79	0	2.79	3.015	+8.3
Structural Steel, base	2.10	2.35	+11.9	2.10	2.10	0	2.10	2.35	+11.9
Sand, per ton	1.25	1.44	+15.2	1.25	1.25	0	1.25	1.44	+15.2
Lumber, 2x4 Fir, per M ft.	55.57	57.85	+4.1	55.32	55.57	+0.5	55.66	57.85	+3.9
Lumber, 2x4 Pine, per M ft.	53.44	54.86	+2.6	53.44	53.44	0	54.46	54.86	+0.7
Common brick, per M	18.29	26.20	+43.2	18.32	18.29	−0.2	20.33	26.20	+28.8
Ready-mixed concrete, c.y.	7.57	7.80	+3.0	7.57	7.57	0	7.64	7.80	+2.1
Struct. clay tile, 3x12x12	84.67	97.38	+15.0	83.73	84.67	+1.1	90.23	97.38	+7.9
Paving asphalt, cars, ton	15.48	15.46	0.0	15.48	15.48	0	15.07	15.46	+2.6



MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	March 1945	March 1946	% Change	Feb. 1946	% Change Feb.-Mar.
Steel (% operating Capacity) A. I. S. I.	96.0	84.4	−12	21.2	+298

	February 1945	February 1946	% Change	Two Months 1945	Two Months 1946	% Change
Fabricated Structural Steel, tons, A. I. S. C.	36,283	45,754	+26.7	79,767	132,125	+66
Cement, thous. bbl. U.S.B. of Mines	4,574	.....	.....	9,447	.....	.....
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	73,599	198,687	.....	118,366	402,739	+241

COST OF LIVING INDEX . . . . CIVIL NON-AGRICULTURAL EMPLOYMENT

	February 1945	February 1946	% Change	Dec. 1945	% Change Nov.-Dec.
Cost of Living Index, N. I. C. B.	105.3	106.7	+1.3	106.7	0.0
Rent (Housing) Index, N. I. C. B.	91.0	91.0	0.0	91.0	0.0
Total Employment (est.), thous., B. L. S.	37,952	35,706	−6	36,339	−2
Constr. Employment (est.), thous., B. L. S.	582	1,095	+88	1,032	+6

MATERIAL COST PRICES

The 20-cities average, compiled by *Engineering News-Record*, indicates a slight upward trend for lumber during the first three months of 1946.

Cement, at Chicago, (per bbl.) maintains its even price of approx. $2.45.

Structural steel, during March, advanced sharply from less than $2.10 per unit to $2.30 as of the latter part of March.

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News of the Week

ENGINEERING NEWS-RECORD • APRIL 4, 1946 • VOLUME 136 • NUMBER 14

No extensive cut expected for heavy construction

Effect of construction curtailment order of Civilian Production Administration will not be as drastic as some anticipated when the order was issued

Many types of construction are not affected by the March 26 order of the Civilian Production Administration (*ENR* March 28, vol. p. 441) forbidding start of construction on certain types of work after that date in order to clear the way for the veterans' emergency housing program. As a result, the total volume of heavy construction work that will be done this year will not be cut as deeply as some had anticipated last week, before the order was issued.

Exempt from the order are highway, street and railway construction operations, bridges, subways, tunnels and pipe lines, all construction other than buildings required for electric utilities, gas, water supply, sewerage, central steam heat and communications; dams, canals, and drainage or irrigation ditches.

Building work stopped

Stopped by the order is all *building* work other than housing (above specified amounts) that was not actually under construction on March 26. The order makes no change in the housing situation which was covered by CPA Priorities Regulation No. 33 (*ENR* Jan. 10, vol. p. 13).

This means that practically all public building work not now under way, other than veterans' hospitals, will be stopped, much industrial and commercial building work, and all amusement facilities. However, the order provides for authorization of prohibited work on a satisfactory showing of need.

The cost limits on exempt building work are given on page 56 of this issue.

Some industrial work

The CPA has announced that it will authorize the construction of factories to produce needed products, such as building materials, also that it will permit construction of factories, stores or other buildings in areas where there is unemployment, or where a structure such as a store is needed by a community.

In most cases, decisions in cases of this kind will be made in the CPA district construction offices.

Under a liberal interpretation of the order such operations as the preparation of foundations for industrial and commercial buildings could go ahead while a determination was being made as to whether the structure itself could go forward without detriment to the housing program.

The order permits all work on water supply and sewage disposal systems to go ahead except construction of buildings costing over $15,000 required for such projects. If this part of the order is interpreted as applying only to the superstructures of filter plants, pumping stations, etc., which might divert materials required for housing, the actual cut in the amount of such work on the program for this year would be small.

On the other hand, if the housing program attains anything like the magnitude now proposed, a very considerable amount of sewer and water-main construction will be required. In some communities this requirement will give added urgency to proposed expansion of water supply sources, filtration plants or sewage disposal facilities.

Flood-control, power, irrigation and navigation projects are unaffected by the CPA order except as they require buildings such as generating stations and pumping plants, which are subject to the $15,000 upper limit.

Effect on construction volume

Analysis of the several classifications into which *Engineering News-Record* divides heavy construction indicates that

(*Continued on page* 56)

Canada reinstates building controls

Federal control over the construction industry has been reimposed by the Canadian government, according to an announcement last week by Reconstruction Minister C. D. Howe.

The move follows the government's announcement last February that it was also reimposing controls over steel construction and fabrication (*ENR* Feb. 14, Vol. P. 247).

The reconstruction chief explained to the Canadian House of Commons at Ottawa that reimposition of controls was dictated by the development of "black markets."

"Because of the critically short supply of many building materials," Mr. Howe said, "a new form of priority system has been worked out for limited use. This new system was designed to assist in channeling the required quantities of building materials as defined in the new order into government-approved low-cost housing projects in order that such projects may be completed as expeditiously as possible."

With certain exceptions, Mr. Howe explained, the new system requires suppliers of building materials to make prior shipments of all orders carrying the new priority rating.

Building materials which come under the new order, as subject to priority delivery, include: Concrete, timber and clay block; common and face brick; builders' hardware; building papers and felts; cement; clay sewer pipe; field tile and flue linings; conduit and fittings; electrical wire and cables; furnaces; glass; gypsum board and lath; coal, gas and oil heaters; insulation material; wood framing, siding, roofing, and outside trim, including sash and frames, interior trim including doors, finished flooring and plywood; nails; paints and varnishes; plumbing fixtures and fittings; and all roofing materials.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Housing—*Minnesota* needs 40,000 new homes now, and 10,000 new dwelling units annually, according to the state's postwar planning council. . . . At *Quebec, Que.*, contractors have been asked for bids on 150 moderate-rent dwellings in the northeast part of the city. . . . In the *Portland, Ore.-Vancouver, Wash.*, area 1,500 units of temporary war housing are being dismantled to be sent to *Los Angeles, Calif.* for veterans' use. *Peoria, Joliet, Granite City* and *Moline, Ill.*, are receiving nearly $260,000 from the state housing board for veterans and long-range housing programs.

Highways—*Alberta* has just awarded four major highway contracts totalling about $724,000. . . . *South Carolina* will repair 600 mi. of roads at a cost of about $1,750,000. . . . *Mississippi* authorized $5,000,000 for improvement of county and rural roads. . . . *Oregon* is receiving bids for road work estimated to cost more than $3,000,000. . . . Lowest bids received March 12 by the *Washington* State Highway Department on six highway projects were 35 percent above estimates. . . . *Hennepin County, Minn.*, plans 27 road improvements for this year to cost about $207,000—*North Carolina* received bids on 16 road projects at $3,643,324—$214,424 over estimates.

Sewage Disposal—*Savannah, Ill.*, plans a new sewerage system to cost $250,000. . . . *Atlanta, Ill.*, has ordered the construction of a $121,000 sewerage system. . . . *Dewitt, N. Y.*, suburb of *Syracuse*, wants to build a sewer system and hook it into Syracuse's treatment plant.

Flood Control, Water Supply, Irrigation—In *Alberta, Canada*, a Red River diversion project is proposed to re-water more than 478,000 acres in the central part of the province. It would cost $6,750,000. . . . Army Engineers at *Syracuse, N. Y.* will ask for bids on three flood control projects in the southern part of the state, to cost about $3,000,000. . . . The *Indiana* Flood Control Commission has approved a $4,600,000 reservoir on Mill Creek, *Putnam County*. . . . Work is expected to start this year on a $10,000,000 flood control and storage dam at *Mt. Morris, N. Y.* . . . *Spartanburg, S. C.*, has announced plans for a $322,000 expansion project at the water works, power and filter plant on South Pacolet River. . . . *Waynesville, N. C.*, has plans for laying over 8,000 ft. of 10-inch pipe from Allen's Creek to the city reservoir as the initial step in expansion of water facilities.

Bond Issues—*Miami, Fla.*, will vote on a proposed sanitary sewer and disposal plant program April 16. . . . *Audrain County, Mo.*, has voted $500,000 bonds for new courthouse. . . . *Yonkers, N. Y.* sold $3,142,000 in long-term bonds for federally-aided housing at an average of 1.2428%—the lowest rate ever on such a project. . . . *Durant, Okla.*, has approved a bond issue of $638,000 for improvements including a city water system from soft water wells. . . . Voters March 12 approved a $1,300,000 bond issue for a sewer system in *Mission Township, Mo.*

Hospitals—Sixteen hospitals and related institutions in *Minnesota* plan to spend $9,926,175 for new construction in 1946 and 1947. . . . Two large hospital groups will be erected on the north side of *Chicago, Ill.*, at an estimated cost of $10,000,000. . . . A site has been chosen by the *Los Angeles, Calif.*, planning commission for a new receiving hospital to cost $1,000,000. . . . In *North* and *South Carolina* a survey shows that nearly $7,000,000 is available for new construction and expansion of hospitals when materials and labor become more easily obtainable.

Railroads group sets up sanitary research project

As a means of providing increased health protection to railroad passengers and employees, the Association of American Railroads has established a sanitation Research Project, to be directed by Abel Wolman, professor of Sanitary Engineering at Johns Hopkins University.

The project will function in collaboration with the Joint Committee on Railway Sanitation—an advisory organization to the association.

Designed to cover all phases of railway sanitation, the first objective of the project is the development of sanitary means of handling and disposal of toilet wastes from passenger carrying cars.

Assisting Mr. Wolman will be: Lloyd K. Clark, project manager, formerly director of the division of sanitary engineering, North Dakota State Health Department, and W. A. Hazlett, as mechanical engineer. Offices and laboratories have been established in the Mt. Clare shops of the Baltimore & Ohio RR, at Baltimore, Md.

Army camp buildings for San Diego housing

An entirely new transaction in surplus property disposal was revealed last week, with the announcement that Camp Callan in southern California would be purchased shortly by the city of San Diego for $200,000. (*ENR*, Feb. 21, 1946, vol. p. 270) Subsequent dismantling of the camp's 650 buildings is expected to provide lumber and materials for houses for some 3500 San Diego veterans.

Many weeks have been required to complete the sale. Federal housing authorities were first required to relinquish all interests to the property, following which Army Engineers appraised the camp thoroughly, at the same time studying possible effects of the transaction before agreeing to sell outright to the city. Final agreement was reached when San Diego's Mayor Harley Knox went to Washington to meet with Army officials and federal housing officials.

Calendar of Meetings

NATIONAL

American Concrete Pipe Association. 38th annual convention, Edgewater Beach Hotel, Chicago, Ill., April 11-12.

American Society of Civil Engineers, spring meeting, Bellevue Stratford Hotel, Philadelphia, Pa., April 17-19.

President's Highway Safety Conference, Washington, D. C., May 8-10.

REGIONAL

Canadian Section, American Water Works Association, annual convention, General Brock Hotel, Niagara Falls, Ont., April 8-10.

Montana Sewage Works Association, Butte, Mont., April 11-12.

Montana Section, American Water Works Association, Finlen Hotel, Butte, Mont., April 12-13.

Arizona Sewage and Water Works Association, Tucson, Ariz., April 18-20.

Florida Engineering Society, 13th annual meeting, Jacksonville, Fla., April 25-27.

New England Sewage Works Association, Pickwick Arms Hotel, Greenwich, Conn., May 17.

Pacific Northwest Sewage Works Association, Gearhart Hotel, Gearhart, Ore., May 22.

Pacific Northwest Section, American Water Works Association, Gearhart Hotel, Gearhart, Ore., May 23-24.

New York State Sewage Works Association, spring meeting, Hotel Hamilton, Utica, N. Y., May 24-25.

Minnesota road workers get pay raise

A new alternative schedule of work, boosting overtime pay for approximately 1,000 state highway maintenance employees, is scheduled to go into effect in Minnesota this month.

Still subject to approval by Civil Service Director Robert Stover and T. G. Driscoll, state business manager, the plan provides cash payments for overtime work in excess of 10 hours a day or 48 hours a week instead of for hours worked in excess of 12 per day and 54 per week.

The new schedule also establishes two rates of overtime pay, one for those in the top half of the salary range based on the top pay in the range, and the other for those in the bottom half based on the middle step in the salary range.

Minneapolis sanitary workers strike

Nineteen employees of the Minneapolis, Minn., sanitation department were laid off recently when no progress was reported in attempting settlement of an AFL jurisdictional dispute.

Four garbage collection trucks were not operating and five were operating with only a single helper instead of two, Hugo Erickson, assistant city engineer, said.

Laid off, he said, were four truck drivers and 15 helpers.

The dispute involves City and Sanitary Drivers union 664 and City Laborers union 363. Union member drivers refuse to carry members of the laborers' union on their trucks as helpers, contending that the helpers should have switched over to the drivers union when they transferred into the department.

23% raise not enough in Boston

More than 500 technical workers, engineers, architects, and draftsmen, employed by Stone & Webster Engineering Corp., Boston, Mass., working on building projects which involve record breaking expenditures have voted to reject a company offer of a wage increase of 23 per cent. Organized as Local 105, International Federation of Technical Engineers, Architects, and Draftsmen, they have been informed by federation leaders that a strike will be called to enforce demands for higher wages.

Hoisting engineers get raise

Threats of a walkout of members of two locals of Hoisting Engineers Local on building projects in Rochester, N. Y., because a wage agreement which was negotiated in January had not been approved by the Wage Adjustment Board were dispelled on March 22, when the approval was received from Washington. There was no explanation of the reason for the long delay.

The agreement, which calls for a wage increase of 15 per cent, retroactive to Jan. 1, will be put into immediate effect by the Rochester Mason Contractors' Association.

Raise approved at St. Louis

Wage increases for 900 structural iron workers and the same number of bricklayers in the St. Louis metropolitan area have been agreed upon by the Associated General Contractors and the Master Builders Association of the city. The rate must be approved by the National Wage Stabilization Board before it can be put into effect.

Under the new scale, effective May 1, journeymen structural iron workers will receive $2 an hour, while ironworkers employed as foremen are to be raised from $2.02½ to $2.25 per hour in St. Louis, and from $2.00 to $2.25 on the east side of the Mississippi River. Bricklayers, under a contract effective as of Feb. 25, will be raised ten cents an hour to a standard rate of $2.00 an hour. This is the second increase for bricklayers within the past year.

Jersey builders appoint group to solve disputes

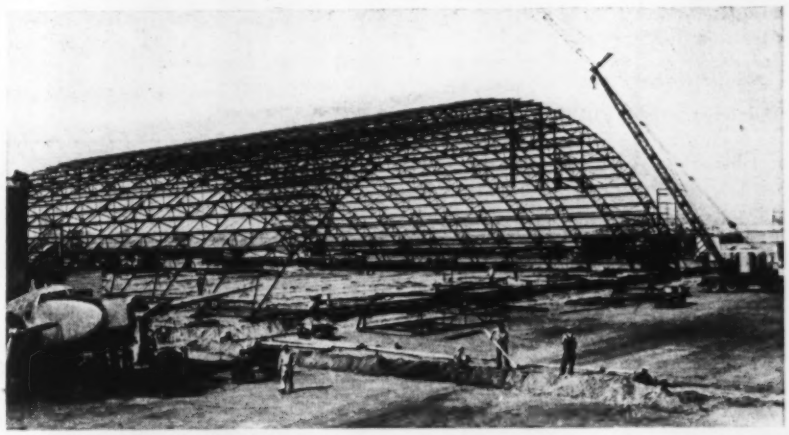
New Jersey contractors, engineers and architects will set up a master committee to begin solution of jurisdictional disputes in their fields as the result of a state-wide "town meeting" held March 22, in Jersey City.

Composed of representatives of the three groups, the committee will study the causes of friction and report recommendations for action to their membership, according to Charles M. Emerson, managing director of the Building Contractors Association of New Jersey.

The chief grievance of the engineers and architects is the "one-stop-service" offered by large contractors who not only handle construction for their customers, but also have engineering departments.

Contractors are objecting to specifications written with general protective clauses which, they claim, force them to gamble on jobs. They also claim specifications are written which are almost impossible to meet because of varying local conditions.

Damon G. Douglas, president of the Contractors Association, opened the meeting and then turned it over to Hudson County Domestic Relations Court Judge David A. Nimmo of Jersey City, who acted as an impartial moderator.



Army hangars erected for civilian use

Three hangars, 200 ft. x 200 ft. in size, purchased from the Lauria Steel and Trading Co., Yonkers, N. Y. and originally fabricated as B-29 Superfortress base hangars, are being erected by Lockheed Aircraft Corp., as additions to its aircraft service facilities at Lockheed Air Terminal, Burbank, Calif.

The 100 ft. radius, arch type trusses shown in accompanying photographs, will be covered by a sheet metal skin, bolted in place. The trusses anchor to heavy column type concrete footings, being attached by a single bolt when the truss is assembled on the ground, in halves, to serve as a hinge when the halves are raised by crane and joined. Then additional footing bolts are placed.

Floors will be six inch thick concrete and doors will be 160 ft. wide. Inside maximum height of the hangars is 50 ft. Two additional hangars are planned, but erection will not be started for an indefinite time. Cost of the three under construction will be $550,000. Consolidated Steel Corp, is the general contractor, with H. M. Keller Co. doing concrete work and Ray Kahl the plumbing. Fire protection is by Fire Protection Engineering Co.; Stolper Electric Co. has the wiring contract, and Abbott Paint Co. the painting.

See no big cut in heavy construction

(*Continued from p. 53*)

the only large cuts produced by the new CPA order will be in the building field. However, even in that field, nearly half as much industrial building work has been let to contract in the first three months of 1946 as was let all last year. This work will go ahead and it is to be expected that, of necessity, other work will be authorized.

Contracts let for commercial buildings to date total to almost the full amount for 1945. Nearly 70 percent of this is large-scale residential work. Most multiple-unit housing work can go ahead under CPA Priorities Regulation 33. And, as noted previously, some commercial work not under contract probably will be approved, but the cut will be much more drastic than in industrial construction.

Public building work already has shown the effect of shortages in building materials. Little will be put under contract except veteran hospitals.

In the aggregate, this might cut one billion dollars from the *ENR* estimate of 3.3 billion dollars of heavy construction to be reported by this journal in 1946, which was a conservative estimate, judged by contracts let to date.

If the objectives of Administrator Wilson W. Wyatt of the National Housing Agency are attained, this cut will be more than offset by small house construction that does not appear in the *ENR* figures for heavy construction.

Administrator Wyatt's objective

Administrator Wyatt hopes that $3.8 billion of housing construction can be carried out in the next twelve months. The Civilian Production Administration estimates that all types of construction will total to $12.5 billion this year, including between $4 and $5 billion of maintenance and repair work and about the same amount of new construction other than housing.

As maintenance and repair work is not normally included in compilation of yearly construction statistics, this estimate would put the total volume of new construction in 1946 at about $8 billion as compared with $3.8 billion in 1945.

Jobs under way are exempt

Work already under way is exempt from the order. Concerning this class of project, the CPA has stated: "The order does not forbid or require authorization for the completion of construction jobs on which materials which are to be an integral part of the structure were incorporated on the site before March 26, and which are being carried on at that date. It does not require further authorization for construction jobs for which preference ratings have been issued under Priorities Regulation 33 (the veterans emergency housing program)." CPA Administrator Small has ruled that if a part of the foundations are in place for a structure, the work can be completed without authorization.

Also, a stadium under way on March 26 can be completed without authorization, although the CPA plans to approve little of this type of construction. However, even through all materials for construction of a new warehouse or other building were on the building site but no construction had been done before March 26, it will now be necessary for the owner to make application to CPA for permission to carry out the project, unless it is exempt as previously explained or the cost is below the amounts set in the CPA order.

Limits set on exempt work

The order does not apply to construction, repair, alteration or installations costing less than $15,000 in the following classifications: A factory, plant or other industrial structure which is used for manufacturing, processing or assembling of any goods or materials, logging and lumber camp, piers (other than for amusement purposes), structures used in connection with a railroad, street railway or airport, bus or truck terminal for contract or common carriers, research laboratories, pilot plants or motion picture sets, structures used for oil, gas or petroleum producing, refining and distribution (other than service stations and garages), utility structures (public or private) providing for electric, gas, sewerage, water, central steam heating, telephone or telegraph communication services.

Limits on small jobs are as follows: $400 for a house or other structure such as a garage on residential property designed for five families or less; $1,000 for hotels, resorts, apartment or other residential buildings for more than five families; $1,000 for commercial and service establishments such as offices, banks, stores and laundries; $1,000 for a farm, $1,000 for a church, hospital and publicly owned buildings. A limit of $200 is set for work not covered above.

How to get approval

When a project requiring CPA approval is planned, application to go ahead with the work should be made on Form CPA 4386 if the construction is a housing project where the houses are to be sold or rented to veterans, and on Form CPA 4423 for all other types of work requiring authorization. The latter class of work includes non-veteran housing. Application blanks can be obtained from all local and regional offices of the CPA.

Applications dealing with veterans' housing construction or those on Form 4386 should be sent to the nearest office of the FHA. When Priorities Regulation 33 went into effect the CPA designated the FHA to process these applications. Regional offices of the FHA, which can also supply copies of Form CPA 4386, were listed in *Engineering News-Record*, Jan. 10, vol. p. 14.

Applications covering other than veterans' housing should be filed in one of the 71 district construction offices which the Civilian Production Administration is now establishing throughout the country for this purpose. Each state will have at least one such office. The location of these offices will be announced soon. In the meantime, FHA regional offices can supply accurate information as to the location of the CPA offices.

Review committees proposed

In each CPA district construction office, the manager, in his decisions on the essentiality and non-deferrability of proposed jobs, will be assisted by an area review committee appointed by CPA. This committee will be made up of citizens of high standing in their communities who represent the geographical sections of the area as well as the economic and public interests within it. The committee will include representatives of the contracting industry and the producers

(*Continued on following page*)

Army surplus material goes to vets' housing

All suitable surplus building materials returned to the United States by the War Department from Pacific Military bases (*ENR* Feb. 21, vol. p. 271) will be transferred to the Federal Public Housing Authority for use in the veterans' emergency housing program.

The War Department announced that 16 ships had arrived at United States ports by the end of March with cargoes, including quantities of lumber, construction materials, prefabricated huts and crated barracks, as well as various items of consumer goods.

On arrival, the cargoes will be inspected by representatives of FPHA to determine what can be used in the emergency housing program. Housing so provided will be made available to local communities and schools for exclusive use by veterans who otherwise are unable to find homes.

Conflicting wage laws pose builders' problem

Building contractors of Rochester, N. Y., are in a dilemma over conflict of state and federal laws concerning wages for laborers. In seeking to bid on state building construction projects they discovered that they cannot comply with a state law fixing minimum wage requirements without violating regulations of the Wage Stabilization Board.

Local contractors have been paying laborers $1.15 an hour, an increase of 15 cents, following ending of the federal labor freeze. But, according to the WSB, the lifting of wage restrictions did not apply to the construction trades—the legal rate is still $1.

Any wage payment beyond that figure is illegal, but on state projects builders must figure their bids on a basis of a minimum wage scale of $1.15 an hour for laborers.

See no major cut in heavy construction

(*Continued from preceding page*)

and distributors of building materials.

CPA's district manager will be the chairman of the committee and he will make the final decision on approval of the applications on non-housing projects such as commercial, industrial, and public works (except federal projects). Appeal from his decision may be made to CPA headquarters in Washington.

In making its recommendations on the essentiality and non-deferrability of local construction projects, the District Construction Committee will review the impact of the proposed job upon the veterans' housing program. Factors which will be considered by the committee, according to the CPA, are: (1) The essentiality of the proposed job in relation to the veterans' housing program, or (2) the elimination of a bottleneck in reconversion; (3) the public health and safety of the community; or (4) unusual and extreme hardship.

Airports affected

As the order now stands, specific authorization must be obtained from CPA before airport projects may be undertaken. Commenting on this phase of the order, the American Road Builders' Association said last week it was making efforts to obtain an exemption for airport projects, which, it said, would be "unnecessarily hampered" by the restriction.

Building code revisions occupy city governments

Continuing evidence of a strong trend toward revision and modernization of city building codes (*ENR* March 14, vol. p. 383) was reported last week as municipalities sought to provide for new business and for greatly increased housing developments.

At Cleveland, Ohio, the city building and law departments turned out a 565-page specification-type building code that would supersede the present code, adopted in 1924.

In New Jersey Governor Edge signed a state legislature bill that permits municipalities to adopt building codes and amendments in condensed form without advertising and without the necessity of including all original provisions of such codes. The act provides that complete copies of the code must be attached to any such ordinances adopted, and must be on file in the office of the municipal clerk so that interested parties will have access to the entire text.

In Oregon the League of Oregon Cities said it was preparing a standard building code, at the Bureau of Municipal Research of the University of Oregon. The resulting standards will be suggested for use by smaller cities and municipalities in the state.

Decry hasty codes

City engineer Win Templeton, of Ogden, Utah, decrying "hastily drawn, badly drawn" building plans, asked city councilmen for an ordinance requiring services of licensed architects and engineers in preparing plans for projected buildings before they are submitted to his office for construction permits.

A flood of poorly drawn permit requests cascading into his office, Mr. Templeton disclosed, are in many cases "presented on butcher paper, tissue paper and cardboard," lacking sufficient information needed to check on soundness of the proposed construction.

Durham, N. C. adopts code

After approximately three years of study by city building officials and a special Chamber of Commerce committee, the city council of Durham, N. C., has adopted a new building, plumbing, and electrical code, the first revisions to be made since 1940.

Major changes include provisions requiring that all house construction from now on have a bathroom for each family, that all houses must be solidly underpinned, that flues and other heating facilities must be constructed more safely and banning the construction of the old-type wood frame tobacco warehouses in the city.

High costs halt bids on state building jobs

High construction cost recently moved the Oregon State Board of Controls to reject a low bid on construction of a patient ward building, at the State Hospital Cottage Farm.

A tie vote among the ten members of the board automatically rejected the $511,930 bid on the structure by Charles R. Schmiedeskamp, of Portland. The bid, board members said, was 50 percent higher than the estimate made last summer.

No bids on New York jobs

For the second time in four months, no bids were submitted for a drainage and grading project on Route 17 between Binghamton, N. Y., and the village of Windsor, although the state has increased its estimate of cost from $255,000 to approximately $288,000.

First bids were to have been opened last Nov. 29, but no bids were submitted. The State Department of Public Works advertised the second time without results.

The project would be on a new alignment of the road to eliminate one of the most hazardous sections on a main highway between Binghamton and New York City.

Boston—It is expected that next June a "Building Center of New England" will be opened at 367-377 Boylston Street, Boston, Mass. It will be a permanent exhibit and information headquarters for all types of building, established as a public service on behalf of manufacturers and designers of building material and equipment for builders, architects and home owners.

The idea is sponsored by business men and organizations interested in better housing and improved techniques in construction.

VA has 105 hospital contracts under way

Private contractors hold 105 contracts for work totaling $43,505,000 for projects scattered throughout the United States which will provide 8,600 additional beds for Veterans Administration patients, the VA announced March 21.

These construction projects are already under way, and are not included in the list of hospitals turned over to the Corps of Engineers recently (*ENR* Feb. 21, vol. p. 265).

Local highway officials' organization completed

The American Institute of Local Highway Administration, organized last January in Chicago at the convention of the American Road Builders' Association, took tangible form in Washington, D. C., recently at a 3-day session of the organization committee.

This organization, which is to represent rural highway officials of the United States under the auspices of the County Highway Officials' Division of the American Road Builders' Association, has for its purpose the assembling and dissemination of information of all types bearing on local rural highway administration, according to Gilbert Smith, Anson, Tex., president of the institute.

The organization, made up of three members from each state delegated by state associations of local highway officials, is modelled along the lines of the American Association of State Highway Officials, but at the local administrative level, explained Chairman Almand. The committee at its meeting drafted a constitution and defined purposes and policies. Members of the organization committee present were: Ed L. Alman, Atlanta, Ga., Andrew L. Burrus, Union City, Tenn.; A. O. Cuthberg, Lansing, Mich.; D. Y. McDaniel, Waco, Tex.; A. J. Thelen, Madison, Wis.; and H. A. Thomson, Drexel Hill, Pa.

Cross-state toll road proposed in Ohio

Construction of a "superspeedway" toll road across Ohio to be built by private capital, and to connect with the Pennsylvania Turnpike has been proposed by County Engineer Donald E. Patterson of Elyria as a feasible solution to part of the state's traffic problem.

Patterson has just completed special studies which, he said, support his theory that a 4-lane superhighway could be built across Ohio as a continuation of the Pennsylvania Turnpike. He believes it would greatly relieve traffic congestion and return a good profit on the capital invested.

The highway would start at the border of the state near Youngstown, go to Cleveland, then on to Toledo and west to the Indiana state line, a distance of approximately 231 miles.

To free bridges

Two highway bridges which the Ohio State Bridge Commission acquired about ten years ago, one spanning Sandusky Bay at Sandusky, and the other the Pomeroy-Mason bridge spanning the Ohio River at Pomeroy, will become toll-free within a year if present rate of traffic continues.

At the time of purchase, $350,000 in bonds were issued to pay original owners for the Pomeroy-Mason bridge. All of these bonds have been retired except $96,000. To purchase the Sandusky Bridge, bonds in the amount of $1,925,000 were issued and to date all but $289,000 have been retired. The commission in a recent report also indicated the Steubenville-Weirton bridge over the Ohio River between those two cities would become toll-free by 1948.

$685,000 improvements for Syracuse, N. Y.

Improvements costing $685,000 have been approved by the city council of Syracuse, N. Y., culminating several weeks' study of the annual report of City Engineer Nelson F. Pitts, which recommended expenditure of $2,000,000 for vitally needed improvements this year.

Since Mayor Costello had decided that the limit would be $600,000, (*ENR* Feb. 28, vol. p. 308) the council had to decide which improvements were most essential. The approved list includes repairs to seven streets and seven sewers and an addition to the City Hospital. The cost of this addition will be $70,000, but it is not included in the limit which was set by the mayor. Advertising for bids has begun.

Missouri may approve county road authorities

A bill authorizing any two or more Missouri counties to unite for the construction, maintenance and repair of highways, roads and bridges—already approved by the State House of Representatives—has recently been reported favorably by the Senate Committee on Election.

The bill would put into effect authority granted in the new state constitution, approved early in 1945, which sets up machinery for special elections to vote on such construction units. A proposition must carry in each county to be affected before such a unit can legally function.

The counties would draw up joint plans and employ district engineers to supervise work. Tax levies up to 35 cents per $100 of assessed valuation are authorized for financing the new districts, when the counties create them.

Wisconsin approves big four-year road program

To continue its program of improving primary and access roads, the Wisconsin State Highway Commission said it will spend $68,000,000 for improvements and extensions within the next four and a half years.

The commission plans 272 separate projects in 68 counties to close gaps and extend routes to interconnect all regions with a grid of primary class "A" roads.

Largest single project is the Capital City Belt-Line, calling for grading and drainage of 17 miles of road around Madison and its four lakes, to relieve the city's business center of heavy through traffic on highways 12, 14, 18 and 51.

E. L. Roettiger, state highway engineer, said that about 5,000 miles of road—half of the total state trunk system—are restricted to gross load limits, and that it would be part of the program to develop all projects with standard year-around capacity. "For many past programs," Mr. Roettiger said, "we spread ourselves too thin as far as subgrade correction and load carrying ability of surface course were concerned—sacrificing these items for length. This resulted in heavy maintenance and resurfacing costs, and limited and inadequate year-around service.

Bids indicate 44% boost in road costs since 1941

Comparison figures of mounting costs in highway construction appeared in Colorado recently when a contractor's low bid of $705,228 was submitted for an 8-mile gravel surface project near Durango. In 1941 low bide on the same project was $488,750. The original offer had been shelved because Colorado's highway department then lacked sufficient funds.

The job was estimated by engineers at $565,865; with allotted funds for the work amounting to $620,436. According to A. F. Hewitt, acting highway engineer, the bid will be submitted to federal authorities for their consideration.

Bids high in Ohio

Perry T. Ford, Ohio highway director, has reported that last year 73 road projects in the state were held up because bids were too high or because no bids were received. Thirty-five more which were awarded averaged 2.38 per cent over the estimates. Early in 1945, Gov. Frank J. Lausche ordered Ford to scan all bids closely, and the report showed that 25 projects had to be readvertised once and two projects twice.

Approve new Tacoma Narrows span

The new Tacoma Narrows Bridge, over Puget Sound, was a step nearer the construction stage last week when the Washington Toll Bridge Authority approved the final plans and specifications for it.

Financing and calling of construction bids will follow as soon as negotiations for the insurance have been completed, according to Clarence B. Shain, state highway director.

Cost of the project is estimated at $8,500,000, and time of construction at 22 months. The new, bigger, and more stable 5,979-ft. suspension bridge, with a main span of 2,800 ft., and four lanes for traffic, will replace the old bridge which failed in 1940 because of aerodynamic instability in one of the most spectacular bridge collapses in history. (*ENR* Nov. 14, 1940, vol. p. 647).

The new design for the bridge, based on the results of a 4-year research program in a specially-designed wind tunnel, calls for a cable spacing of 60 ft. and stiffening members of the trussed type, 33 ft. deep, instead of the 8-ft. deep plate girder stiffening members of the old bridge. Open truss floorbeams will be used rather than plate girders and the roadway will be slotted.

The report was submitted to the authority after years of painstaking research conducted at the University of Washington by Prof. F. B. Farquharson, director of the experimental station there, under the direction of Charles E. Andrew. The experiments involved construction of both a scale model of the old bridge, (which developed a strange "ripple" under brisk winds, eventually causing its collapse) and a scale model of the proposed new structure.

Investigations and tests on redesign of the bridge (*ENR* Nov. 29, 1945, vol. p. 716) have been under the direction of a consulting board of which Mr. Andrew is principal engineer and chairman. The other members are Glenn B. Woodruff, San Francisco; John I. Parcel, of Sverdrup & Parcel, St. Louis, and Theodor von Karman, California Institute of Technology.

Plumbing anti-trust trial set in Ohio

Trial of 102 associations, companies, individuals and labor unions occupying prominent positions in the plumbing industry, on charges of violation of the Sherman anti-trust law, will start in the Cleveland, Ohio, Federal District Court on Oct. 28, 1946.

Resulting from an extensive investigation conducted by the Department of Justice in 1939, the defendants are accused of applying a "restricted system" of distribution to add some 15 to 40 percent in costs to the consumer on plumbing supplies as compared to costs for comparable supplies coming from either mail order houses or producers who sell on a "direct-to-you" basis. The government charges that the consumer cannot escape the artificially created net price since members of the plumbers union refuse to install fixtures other than those made by selected equipment manufacturers.

Heading the list of companies indicted are the so-called "Big Three"—Crane Co., of Chicago; Kohler Co., of Kohler, Wis., and the American Radiator & Standard Sanitary Corp., of New York—said to be producers of about 70 percent of all cast iron enamelware and vitreous chinaware and more than 50 percent of the sanitary brass goods used in the plumbing industry. Others named in the indictment include Plumbers Union Local No. 55 of Cleveland, Ohio and the Dade County Master Plumbers Association of Miami, Florida.

The Government charged that plumbers, through understandings reached with those members of the master plumbers who follow the "restricted" method, have been able to set up artificial regulations and requirements governing the amount of time to be spent in making installations, the amount of work to be done each day, and the number of plumbers required on a job.

A survey of independent agencies in Cleveland showed that although the average house has four major plumbing fixtures—kitchen sink, bath tub, toilet, and wash basin—eight days is now the usual time taken by a Cleveland plumber to make these installations. Formerly five days were sufficient. Should a toilet and wash basin be installed on the ground floor, four additional days are required. In a bungalow type house, six days are usually required.

Although the indictments were returned in February, 1940, at the request of the War Department the trial was not pressed during the war years since most of the defendant companies were engaged in war work.

Gen. Somervell to head Koppers Co., Inc.

Gen. Brehon B. Somervell, U. S. Army, retired commander of the Army Service Forces in the recent war, on March 25 was elected president of Koppers Co., Inc., Pittsburgh, Pa., and will take office on May 1. The company builds and operates coke and other coal byproducts plants in twenty-four states where such products as road tars, wood preservatives and waterproofing materials are made.

J. P. Williams Jr., who has been acting as president and chairman of the board since the death of J. T. Tierney in 1944, will continue as chairman.

A statement issued by the board of directors said that "General Somervell has not only a proved capacity for leadership, but also a splendid engineering background. His Army experience over many years has been devoted primarily to business and industrial problems."

N. Y. structural engineers learn of new building code

Bernard A. Savage, commissioner of the New York Board of Standards and Appeals, speaking last week at the annual meeting of the Structural Engineers Society of New York City told about a national building code now being prepared by George E. Strehan, a member of the society, for the Building Officials Conference of America. The new code will be based on performance rather than specification of definite material and will be in three parts: (1) what to do—a compilation of essentials that are standard and applicable throughout the country; (2) how to do—a loose-leaf section of properties of all materials arranged so that it can be kept up to date, and (3) a code applicable for small cities with emphasis on the problems of communities of 5,000.

A section on prefabrication from this new building code will be ready for release in a few weeks.

A "Building Officials Foundation" is to be established that will test materials and approve the materials necessary for building, somewhat as *Good Housekeeping* does for household goods and appliances. It is planned to ask industry soon to subscribe $350,000 to establish the foundation.

Snyder elected president

New officers were elected as follows: Howard H. Snyder, president succeeding F. R. Mac Leay; Sidney Frieman and A. L. Stevenson, vice presidents. Louis D. Antona was reelected treasurer, and Matthew Hiller secretary.

Ohio approves $4 million sewage plant for Toledo

The Ohio Health Department has approved a $4,460,000 long-range program for expanding the sewage disposal works to provide complete treatment in Toledo.

The program, under consideration for some time would include extension of the present sewage plant site in Bay View Park by constructing a seawall and filling in the mooring basin northward of the site, construction of a secondary treatment works of the activated sludge type, and installation of a chlorine contact tank. Also included are erection of a power plant to utilize sludge gas, and revision of the present sewage digester system with added sludge storage tanks, concentrators, and additional gas storage tanks.

Worcester must improve system

The Public Health Department of Massachusetts has informed the city of Worcester that remedial measures must be taken at once to repair the city sewage disposal plant, the deterioration of which is attributed to an excessive amount of acids and refuse in the industrial wastes which have increased greatly during the war period.

It is estimated that $2,000,000 will be required to rebuild the plant.

Film aids disposal planning

Designed to illustrate forcefully to city and industrial officials, city planning agencies, and the general public the benefits to be derived from proper sewage and industrial waste treatment, is a new all-color General Electric Co. sound movie titled "Clean Waters".

The film, which is now available to interested organizations and meetings, uses colorful action shots to show the deleterious effects of wanton sewage and waste discharge into streams and coastal waters; it then depicts in a non-technical manner how those conditions may be remedied through the use of suitable treatment facilities.

Complete Bailey-type span on Indiana highway

Reportedly the first installation of its kind for civilian use in the Midwest, an Army Bailey-type bridge has been completed over the Patoka River on U. S. Highway 164, near Jasper, Ind.

The bridge was erected by G. H. Allen of Vincennes, and was opened to traffic just 48 days after the contract was awarded. The span measures 113 ft. 6 in., and replaces a pontoon bridge used following damage to an old bridge at the site.

Army engineers restore North Pacific Division

The North Pacific Division, Corps of Engineers, U. S. Army—merged with the South Pacific Division during the war—has been restored to its pre-war status, the War Department has announced. This gives the Corps of Engineers thirteen divisions and 49 districts.

Division headquarters is at Portland, Ore., and will include the Portland and Seattle districts, covering Washington, Idaho, Oregon and Montana.

The present Pacific Division, with headquarters at San Francisco, has been redesignated the South Pacific Division and will be comprised of the Los Angeles, San Francisco and Sacramento Engineer districts, covering California, Nevada, Utah and Arizona. The division engineer will continue his duties as service command engineer, Ninth Service Command.

For the Northern Pacific Division, Col. Theron D. Weaver, formerly head of the Repair and Utility branch, Office of the Chief of Engineers, has been named division engineer. For the new Southern Pacific Division, Col. Edwin H. Marks has been named division engineer.

Quebec repairs bridges

The Province of Quebec, Canada, should spend about $100,000,000 to rebuild and repair about 4,500 bridges now considered unsafe, Romeo Lorrain, Minister of Public Works, said recently.

Tulsa, Okla., to start water supply improvement

The city of Tulsa, Okla., last week asked bids for clearing of a 170-acre site at Mohwak, Okla., for construction of a new reservoir.

The reservoir will be part of a $3,000,000 water department improvement program recently authorized at a special election to increase the storage capacity available to the city.

Rochester, N. Y., seeks bids

Lining and cleaning of a little more than 5 miles of conduit 2 of the Rochester, N. Y., water system between Hemlock Lake and Rush Reservoir will be done this spring, it was announced by Kenneth J. Knapp, city engineer.

The cost is estimated at about $121,000.

The conduit is to be relined with machine-placed mortar.

Karl Terzaghi receives Franklin Institute award

Karl Terzaghi, consulting engineer and research consultant to the University of Illinois, will receive the Brown Medal of the Franklin Institute at an annual "Medal Day" ceremony to be held in Philadelphia April 17.

The medal, first awarded in 1941, is presented to inventors for discoveries and inventions involving improvements in the building and allied industries.

JOBS OF THE WEEK

RESIDENCES, Philadelphia, Pa.

Warner West Corp., Upper Darby, Pa. will construct residences by separate contracts to cost $20,000,000.

RESIDENCES, Clifton Heights, Del.

Warner West Corp., Upper Darby, will construct 500 residences by separate contracts. The estimated cost is $4,000,000.

SHIPYARD BUILDINGS, San Francisco, Calif.

James I. Barnes Construction Co., San Francisco, Calif., was the lowest bidder at $2,290,000 for superstructure for a 2-story, shop building, shipfitters and boilermakers shop, small structures when Bureau of Yards & Docks, Navy Department, Arlington, Va. opened bids.

IMPROVING RUNWAYS, East Boston, Mass.

DeMatteo Construction Co., Quincy, Mass., was the lowest bidder for constructing runways, taxiways, service and access roads at General Edward Lawrence Airport, by the Commonwealth of Massachusetts, Boston, at $2,302,681.

RECONSTRUCTING LOCK NUMBER 2, Braddock, Pa.

U. S. Engineers, Pittsburgh, Pa., received the lowest bid for reconstructing Lock No. 2, on Monongahela River from Dravo Corp., Pittsburgh, Pa., at $6,077,105.

Note—Additional bidding and contract news on many projects large and small, including the above items appear in the Construction News section beginning on page 167.

OBITUARY

Robert W. Boyd, 66, civil engineering graduate of New York University in 1899, who during the first world war headed the concrete ship construction section of the U. S. Shipping Board, died at Scarsdale, N. Y., March 22. Following the first war he joined the Turner Construction Co., New York City. During World War II he had charge of construction in war plants for the Turner Co., and retired last September.

Marion R. Kays, Sr., 65 area construction engineer with the Federal Housing Authority at Atlanta, Ga., died March 13.

Thomas W. Wright, 69, retired civil engineer of Bridgeton, N. J., died at St. Petersburg, Fla., March 13.

Joseph T. Gallagher, 87, retired contractor of Chicago, Ill., who as a member of Gahan and Byrne, superintended the construction of the Chicago drainage canal and the sewer and drainage system of the World's Columbian Exposition in Chicago in 1893, died March 18 in St. Petersburg, Fla., where he had been living in retirement.

Axel F. Enquist, 75, retired construction engineer, died Mar. 24 at his home in Washington,. D. C. A native of San Francisco, Calif., Mr. Enquist was a Washington resident for 40 years.

Charles A. Juergens, 78, retired building contractor of Danville, Ill., died there March 19.

Clarence E. Madden, 71, since 1941 district supervisor of the maintenance division, Maine State Highway Department. died at Augusta Mar. 15.

Edwin Morgan Hall, 63, at one time president of Clapp, Riley and Hall, equipment company, of Chicago, died Mar. 10 in that city. He was an engineering graduate of the University of Wisconsin, class of 1904.

Henry D. Dewell, 65, authority on timber structures and earthquake resistant construction, died March 20, in Berkeley, Calif. After being graduated from the University of California in 1906 as a civil engineer, Mr. Dewell entered private engineering in San Francisco and in 1915 acted as chief structural engineer for the Panama Pacific International Exposition. Since that time he had been a consulting engineer and recently was associated with his son, Robert D. Dewell. Mr. Dewell took an active part in development of building codes for regions subject to earthquakes.

James A. Lyons, Sr., 63, heavy construction contractor of Portland, Ore., died there March 14. He was president of J. A. Lyons Co. Inc.

Charles Leonard of Portland, Ore., partner in Leonard & Slate Oregon, Ltd., and **Jack Ware** of Troutdale, Ore., superintendent in charge of highway construction for the company, were killed March 14 when a truck in which they were riding was hit by a train near Portland. Mr. Leonard was graduated from Oregon State College in 1909 and served as deputy county surveyor and county engineer of Linn County, Ore., from 1910 to 1933, when he went into the contracting business.

Robert Charles Norman, civil engineer of Seattle, Wash., died there March 11. He was employed as an engineer by the Allis-Chalmers Manufacturing Co.

Prof. Allen H. Kimball, head of the architectural engineering department at Iowa State College, Ames, Iowa, died March 8.

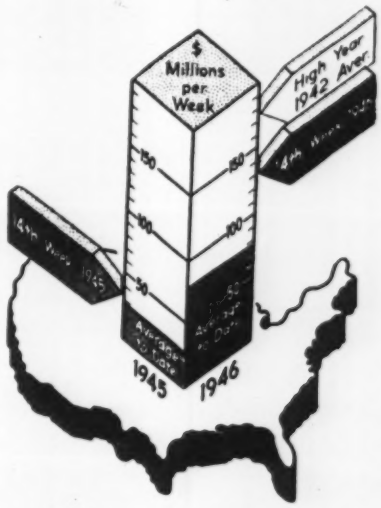
Lee Harvey, 77, for 41 years superintendent of the water department at Conneaut, Ohio, died March 17. He retired in December, 1942, as the oldest municipal employee in that city.

Arthur S. Bedell, associate sanitary engineer in the New York State Health Department since 1925, died March 30 at Delmar, N. Y. Born in Brooklyn, he was graduated from Dartmouth College and the Massachusetts Institute of Technology. He was professor of mathematics and registrar at Robert College in Istanbul, Turkey, for several years, and later was with the Utah State Department of Health. He was a charter member and secretary-treasurer of the New York State Sewage Works Association for twenty years, and a member of the American Public Health Association.

Correction

In an article in Engineering News-Record February 28, vol. p. 320, Fred M. Morris, of Toledo, was listed as architect of a new airport administration building at Toledo, Ohio. Mr. Morris is an associate of the Toledo Industrial engineering firm of Forster, Wernert & Taylor, which is architect for the work.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars) Week of	April 4 1946	Cumulative 1946 (14 wks.)	Cumulative 1945 (14 wks.)
Federal	$10,975	$120,900	$246,234
State & Mun.	40,148	257,116	49,061
Total Public	$51,123	$378,016	$295,295
Total Private	79,870	733,260	118,621
U. S. Total	**$130,993**	**$1,111,276**	**$413,916**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of work	Dollar Volume (Thousands) This Week	Cumulative 1946 (14 wks.)	Cumulative 1945 (14 wks.)
Waterworks	$1,232	$28,200	$9,545
Sewerage	1,921	14,077	8,582
Bridges	2,438	26,827	7,757
Highways	23,767	135,597	30,298
Earthwork, Waterways	4,796	74,461	9,712
Buildings, Public	12,172	72,921	180,067
Industrial	13,608	267,519	85,523
Commercial	64,989	425,039	21,979
Unclassified	6,070	66,635	60,453

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; Industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (4 wks.)	Cumulative 1945 (14 wks.)
NON-FEDERAL	$224,886	$181,228
Corporate Securities	93,967	41,867
State and Municipal	130,919	125,061
RFC Loans		14,300
FEDERAL	158,320	77,137
Total Capital	$383,206	$258,365
Index Base = 100	**1913**	**1926**
Construction Cost	Apr. '46 334.59	160.83
Building Cost	Apr. '46 254.37	137.50
Volume	Mar. '46 256	112

EDITORIALS

VOLUME 136 NUMBER 14

April 4, 1946

Pontoon Cell Salvage

ONE OF THE MOST EFFECTIVE items in our military construction kit-bag was the 5x5x7-ft. steel pontoon cell, and yet to date there has been surprisingly little interest shown in saving it from the scrap pile and adapting it to peacetime use. Both private agencies, who can buy them for $45, and government departments, who can acquire them for nothing, are thereby wasting an opportunity and overlooking an investment. Developed by a Navy Civil Engineer Corps officer, and popularly known as Seabee pontoons although officially designated as NL or Navy Lighterage pontoons, the 1,000-gal. capacity steel boxes were assembled into barges, floating piers and airplane runways, sunken causeways, drydocks, water tanks, asphalt heaters, pontoon bridges and dozens of other ingenious contraptions. Why these and other assemblages could not be adapted to peacetime construction, it is difficult to see. Great numbers of these buoyancy units are stacked in depots at various ports whence it was planned to ship them overseas to the Navy Seabees and the Army Engineers. Most or all of them now have been declared surplus for disposal. Every construction contractor and government construction agency should examine their future plans in the light of the possible usefulness to them of these handy little units, before permitting them to be consigned to the scrap melting furnaces.

Lend a Hand to Housing

Now that the construction curtailment order has been issued defining the rules that will govern priorities, prohibitions, and exemptions, there is every reason for everyone in the industry to go to work with a will. The sooner living accommodations are in process of creation, the sooner can controls be removed and complete freedom of initiative be restored to all who wish to build, anything, anywhere. Moreover, if the housing problem is attacked with the concerted, enthusiastic effort that it deserves, the resulting push given to the materials-manufacturing industries will provide them with the capacity to supply other types of construction, probably more quickly than otherwise. And it is this flood of materials, too, that will stabilize and then reduce costs. CPA Administrator Small and NHA Administrator Wyatt have exhibited statesmanship and understanding in drawing up the curtailment order. Disregarding a natural temptation to proclaim a holy crusade for housing at the expense of every other type of construction activity, they used a scalpel instead of a broadax, and have placed restrictions only where they seemed least likely to affect broad economic recovery and where they would directly save materials for housing. Administration of any restriction order, however well-conceived, will present difficulties, but if the order is executed with the same finesse that characterized the drafting, substantial results are possible. Both their certainty and their size depend first and foremost on how manufacturers, the OPA and labor solve the problem of materials production. After that it is up to everyone in the construction industry who has any of the facilities or the know-how needed to lend a hand. Housing is the nation's first order of business for many months to come.

An Excavating Challenge

PROCEDURES UNDER CONSIDERATION by the Army Engineers for deepening the Panama Canal to sea level are a challenge to the dredging fraternity—contractors and manufacturers alike. Excavating some three quarter billion cu. yd. of material, nearly half of it rock, under canal traffic, with possible dredging depths up to 135 ft., pose new unprecedented dirt-moving problems.

Solution to these problems was sought by Army Engineers representing The Panama Canal at a recent conference in Philadelphia attended by dredge operators and manufacturers. There the staggering magnitude of the project was revealed, along with two possible construction approaches: (1) three-stage excavation involving successive removal of lock flights; and (2) single-stage operation requiring 135-ft. dredging. Risks and difficulties in removing the locks one flight at a time, requiring underpinning, huge cofferdams and perhaps temporary but costly installation of the third set of locks for safety, make serious consideration of the deep dredging plan mandatory.

And unprecedented as this plan may be, its problems are not insurmountable. Nevertheless, the dredging fraternity must think beyond present practices and equipment. The necessary new concept of subaqueous excavation can spring only from

unfettered imagination and application of ingenuity. For example among the possibilities already discussed are: deep-draft hydraulic dredges with the first pump placed on the keel far below water to reduce the suction lift; underwater bracing of long spuds; improvement of anchor line operating technique to eliminate use of spuds; ladder dredges to cut 135 ft.; spoil disposal by belt conveyors, say on barge-mounted flights; and dipper dredges with a back-pull at the top of the long dipper stick to boost the crowding action. Even more revolutionary ideas must be brought forward and examined.

One thing is clear. The engineers should not be restricted in their decisions by lack of equipment to do the job. They will not be if the precedents recorded in the history of American construction enterprise are followed. But this excavating challenge is so great that extra emphasis on the need of meeting it are justified. From among the dredging fraternity, or perhaps from some other element of the construction industry, must come the initiative, the courage and the brains that will make 135-ft. dredging practical.

Multiple Housing for Veterans

TOO LITTLE DISCUSSED among the various proposals for meeting the housing crisis is the important contribution that can be made by multiple dwelling projects of the type previously built in connection with slum clearance. In contrast to the single-family residential unit, the construction of multi-family apartment houses would appear to offer important advantages. Briefly here are some aspects that deserve consideration:

Construction facilities—Apartment building is a "heavy" construction operation on which can be employed the facilities and equipment of the big contractors whose skills and organizations under no other circumstances could be made available on housing work as readily or as efficiently.

Materials—Many of the required materials are of a different type or size from those normally used for single-family dwellings. For example, cement, brick, tile and structural steel rather than lumber would be employed for framing and enclosure; and for heating and plumbing the larger sizes of pipe would predominate and thus lessen competition for the badly needed smaller sizes of these products.

Production speed—Efficiency of large contracting operations should be able to produce living units faster. For example, a 207-family project built by the New York City Housing Authority under the impetus of national defense was made ready for occupancy in 5½ months; even in normal times this organization is able to move families into a 1,000-unit project within ten months after start of construction. With two or three-shift operation and a greater recognition of the need for speed this time element could be materially reduced.

Cost—Experience with large-scale multiple housing construction indicates that a $3,500 unit cost (4 room apartment) is a pretty good average; with prices adjusted upward over those prevailing in 1940 the unit cost probably would be in the neighborhood of $5,000. Land and all other development costs might add as much as $3,000 per unit, making the total about $8,000. While this is somewhat higher than the figures quoted for veterans' housing, it should be pointed out that the cost is based on the use of the high-priced land to be found in central city areas and consequently a part of this cost might properly be charged off to urban rehabilitation. Furthermore, this type of housing has a much longer life than single dwelling construction affords so that it represents a better investment.

Rental units provided—Quite aside from all these reasons why our established experience in multiple dwelling construction should receive closest scrutiny is the fact that here is a way to provide economical rental units. And if a survey made by a New York State joint legislative committee means anything, three out of every four veterans prefer to rent rather than buy housing accommodations.

Apartment house construction will not solve the housing problem, but it will aid in the effective marshalling of all of the construction industry's resources, will promote the use of materials in less critical demand, will expedite the completion of living units, and it will provide a permanent investment in urban rehabilitation and furnish desirable rental opportunities for veterans. As compared to acres of hastily-built single family houses, steel- or concrete-framed multiple housing projects deserve more emphasis rather than less in our stepped-up program of housing construction.

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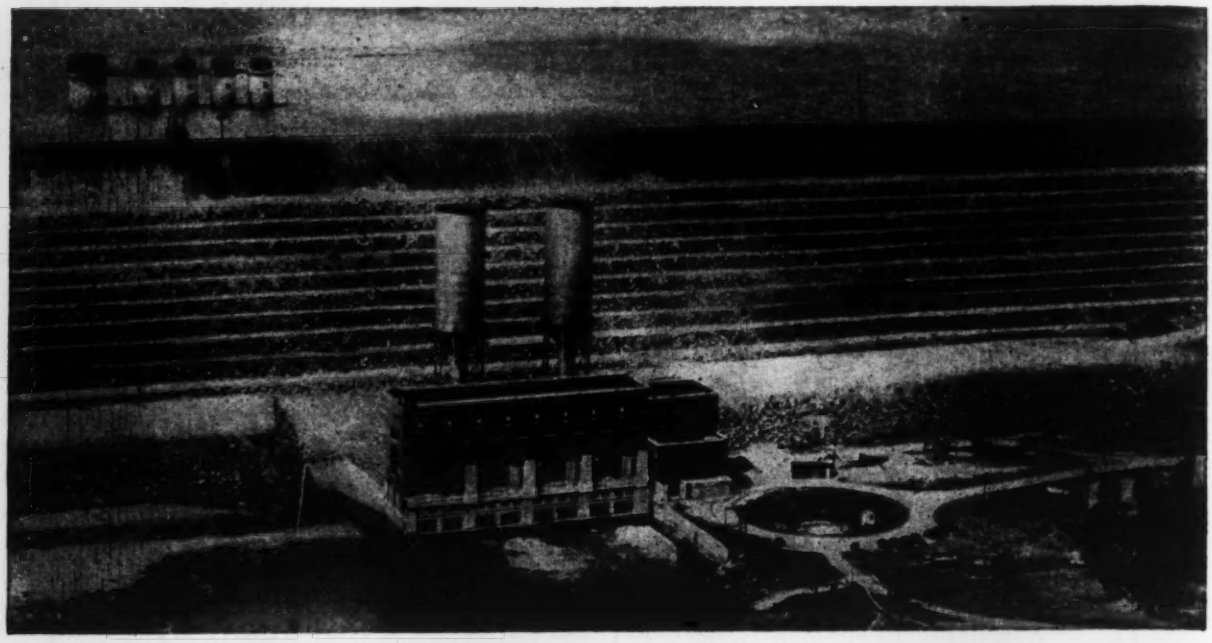


Fig. 1. To add to the stability of Saluda Dam its downstream slope was flattened by adding terraced layers of loose rock.

Saluda Dam Reinforced

Allen W. Reid
Hydraulic Engineer, Gilbert Associates, Inc.
Reading, Pa.

***Contents in Brief**—Soon after the completion of Saluda Dam in 1930, saturation conditions at certain points in that large earthfill structure necessitated unusually extensive inspection and maintenance. A review of the design by more recent methods resulted in the installation of a rock blanket on the downstream slope and a large addition to the spillway. More than half a million cubic yards of rock, excavated for enlargement of the spillway channel, were placed on the dam in 10-ft. terraces by means of motor trucks.*

SALUDA DAM, an earthfill across the river of that name ten miles west of Columbia, S. C., was the outstanding structure of its type when it was built in 1930. It is 7,800 ft. long, 208 ft. high above the river bed, and contains about 11,000,000 cu. yd. of earth, with a wide core placed by the semi-hydraulic fill method. Although exceeded in volume by Gatun Dam in the Canal Zone, it was 88 ft. higher than that structure, thus marking a bold advance in earth dam construction.

The original structure had an upstream slope of 1 on 3, which was protected by riprap, and a downstream slope was 1 on 2½. (*ENR* April 25, 1929, vol. p. 669). Except for a rock toe of only 15,000 cu.yd. across the old river channel, the dam was built of the red and brown residual soils typical of the region, which are almost entirely free of rock. The foundation material is relatively impervious.

Beneath the dam, close to the former river channel, are four concrete-encased steel penstocks, founded on rock. Adjoining the penstocks there is a concrete arch culvert large enough to accommodate a future installation of two additional penstocks. A power house having a rated capacity of 130,000 kw. is located close to the toe of the dam.

The original spillway is a concrete structure, built on rock adjoining the south end of the dam. It is equipped with four tainter gates, each 37 ft. 6 in. wide, with sills 20 ft. below normal full reservoir level. These gates discharge into a former creek bed entering the river 3,000 ft. below the dam.

The area of the lake at its normal elevation is 80 sq. mi. and the drainage area above the dam is 2,400 sq. mi.

Poor drainage becomes evident

A few months after completion of the dam the appearance of some wet spots on its surface caused a thorough investigation of its internal condition. Forty-six wells were driven for the purpose of obtaining a periodic record of the line of saturation at selected points. The earlier wells, consisting of 2-in. pipe washed down to the required depth, frequently clogged. Later wells were driven with a churn drill making a 6-in. diameter hole. A 2-in. pipe, fitted at the bottom with a well point, was then placed in the hole, and the

space around it filled with gravel to a point 8 ft. below the surface. The remainder of the hole was filled with well-packed earth to keep out surface water.

Supplementing the well observations, samples of earth were obtained with an earth auger at various depths and analyzed for moisture content.

In addition, several horizontal tunnels 100 ft. to 250 ft. in length, 3 x 5 ft. in section, were driven for examining the core material and providing drainage. They were lined on top, bottom and sides with 4-in. plank spaced one inch apart.

As a check on settlements, accurately aligned monuments were set at 500 ft. intervals along the top of the dam, and their exact elevations noted.

In June, 1932, a slough about 200 ft. in length and 10 ft. high occurred near the toe of the dam at a point about midway between the original river channel and the south end. Examination of adjacent areas showed a general sogginess along the toe for a distance of about 2,000 ft.

Attention was first given to repairing the sloughed areas, bringing them into a stable condition before heavy rains occurred. Several trenches were excavated, starting at a longitudinal drainage ditch along the toe of the dam and extending up the slope to the pits left by the sloughed material. The pits, sloping ditches and longitudinal ditch were filled with "one-man stone." A new drainage ditch was dug farther out, with laterals communicating with the stone-filled original ditch. This not only provided adequate drainage for the affected areas, but the rock-filled sloping drainage ditches backed at their lower ends by original earth, acted as struts to hold the upper parts of the fill in place. The whole area was then covered with earth, burlap

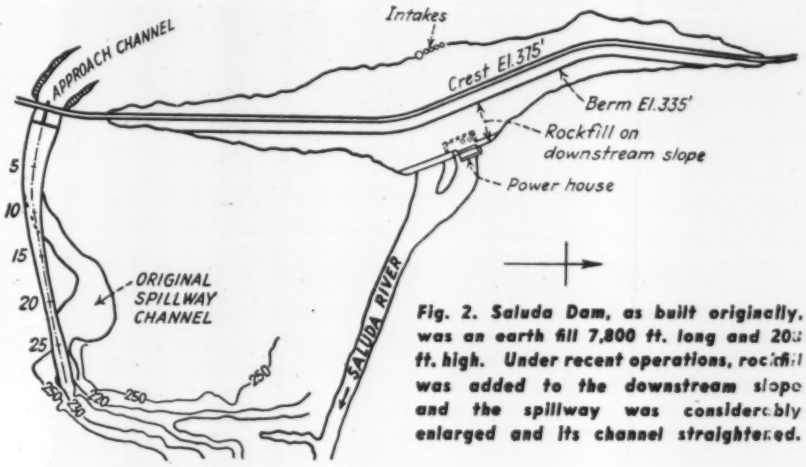
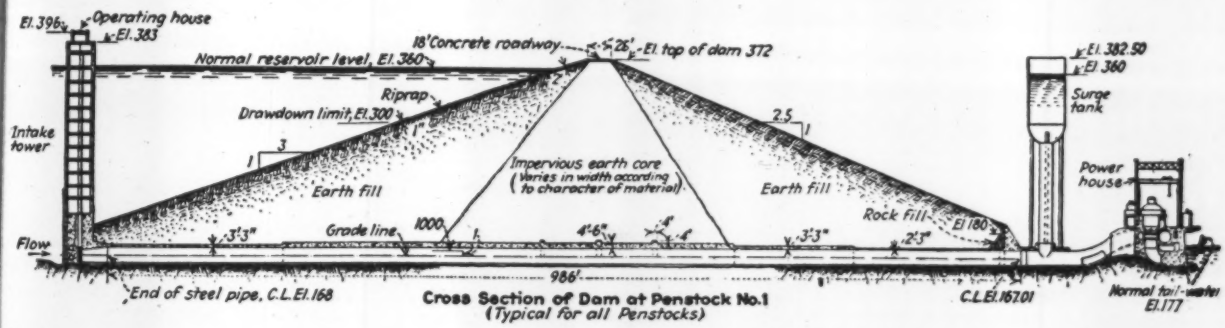


Fig. 2. Saluda Dam, as built originally, was an earth fill 7,800 ft. long and 203 ft. high. Under recent operations, rockfill was added to the downstream slope and the spillway was considerably enlarged and its channel straightened.



Cross Section of Dam at Penstock No. 1
(Typical for all Penstocks)

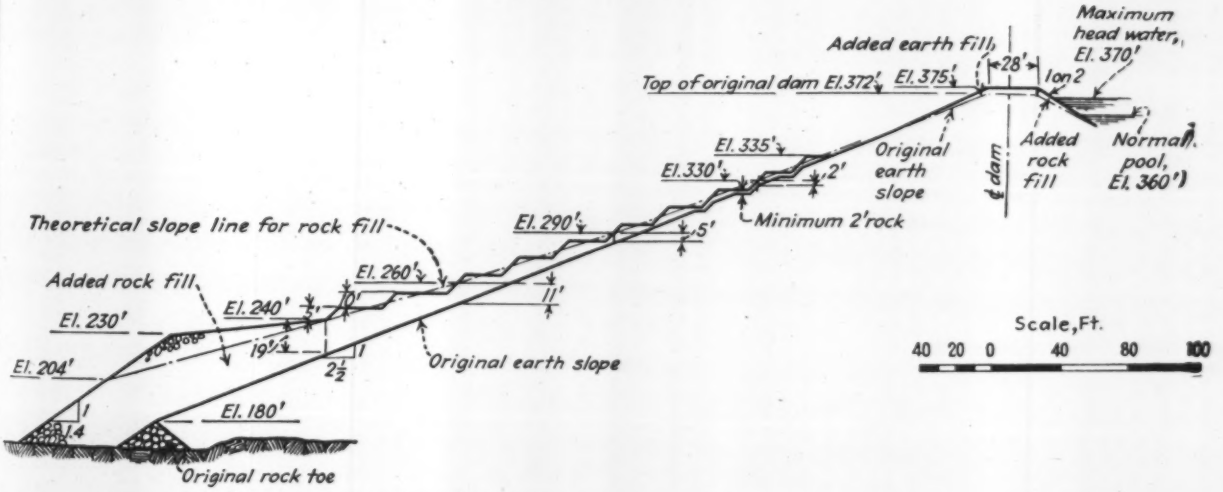


Fig. 3. Sections through Saluda Dam, as built originally and as enlarged in the recent work. The full section at the top is reproduced from Engineering News-Record of April 25, 1929. The lower section shows how rock taken from the spillway channel was added at the downstream toe and up the lower face of the dam in 10-ft. terraces.

being first placed over the stone.

As rapidly as possible, steps were taken to drain the remainder of the soggy area. Deep trenches, in some cases as close as 30 ft. apart, were carried up from the toe into the wet section and filled with stone. Several tunnels were driven above the wet area to intercept the seepage.

When the material encountered became too wet for extending a tunnel farther, a series of vertical shafts was sunk at points higher up the slope with the aid of sheet piling. Pipes were pushed through the earth to connect the bottom of the lowest shaft to the tunnel and the bottom of each succeeding shaft to the next shaft below it. As completed, the shafts were filled with stone, a layer of fine material 6-in. thick being placed around the outside to act as a filter. The piling was then withdrawn.

A check of the saturation lines over the entire downstream face of the dam was made by hand boring. A hole was first bored through the dry cover with an earth augur. When sticky material was reached, the augur was withdrawn and a half-inch pipe inserted, having a cross bar at its top. After the depth of the hole at this point was noted, it was determined how far the pipe could be pushed down by the weight of three men, and how much additional depth could be gained by turning the pipe. Very soft material was encountered at widely varying depths. Once reached, it could be penetrated by the pipe alone to an additional depth of 5 to 10 ft.

The information obtained from these borings was very useful in deciding where to locate additional drainage ditches, tunnels, shafts and wells.

Water levels in the wells were observed at intervals varying from 24 hours to 10 days, depending on the amount of dry cover and the rapidity with which the lake elevation was rising. It was found that, in general, the trend of water elevation in the wells followed that in the lake, after a time lag of two to four weeks. Discharge from the drains varied with the lake level in a similar way.

Drainage system extended

From 1933 to 1937, the drainage system was greatly extended. Finally, there were 30 tunnels 3 x 5 ft. in section, having a total length of 3,822 ft., 106 vertical shafts 4 x 6 ft., with a total depth of 1,967 ft., and 98 drainage ditches, whose combined length was 7,309 ft.

Forty points were established for the measurement of seepage. To obtain the lines of saturation, there were 108 drilled wells with a combined depth of 3,478 ft. Over 240 steel-pipe monuments were installed for measuring vertical and horizontal movement on the downstream slope.

Due to prompt action by the maintenance crew whenever the line of saturation rose to a critical point, no sloughs occurred after the initial one. The measures used were invariably successful in drying up areas where trouble was indicated.

The observations of settlement and horizontal movement were useful both for ascertaining that there was no abnormal displacement, and for estimating the state of compaction of the earth.

As might be expected, movement occurred much more rapidly during a quick dropping of the saturation lines in the dam than during a long period of relatively stable water conditions. Of the total settlement which has taken place during the 16 years since completion of the dam, 85 to 90 percent occurred during the first seven years. The settlement at the top of the dam across the original river channel, was about 3 ft., the depth of fill being about 200 ft. Vertical settlement was usually accompanied by downstream movement averaging 50 to 85 percent of its magnitude. In general, the lower the elevation, the greater was the ratio of downstream to vertical movement.

Design studies reviewed

Advances during recent years in soil mechanics and in methods for predicting flood flows led to a review of the design of both the dam and the spillway. A large number of undisturbed earth samples were obtained from the dam and tested for shear strength and other physical properties. Analysis by the "dangerous-circle method" (*Engineering for Dams*, p. 732) indicated that the downstream section had an unsatisfactory margin of shear resistance.

At the same time, thorough studies of possible flood volume were made, both by empirical and by the transposed-storm method. Consideration of unprecedented floods which occurred throughout the region in 1929 and 1936, after the Saluda Dam was designed, made it evident that greater spillway capacity should be provided.

With the realization that there is no limit to a "possible flood," but that some limit must be arbitrarily placed on a combination of remotely possible contingencies, the "design flood" was finally determined as that produced by the greatest storm known in the region, with its rainfall pattern transposed and oriented to produce maximum precipitation in the Saluda River basin, and the resulting runoff increased 50 percent. The runoff volume of this flood is 2.75 times that of the greatest flood known at the dam site.

The criterion for spillway capacity was that during such a flood, starting when the reservoir was at normal full elevation, the water should not rise higher than five feet below the crest of the dam.

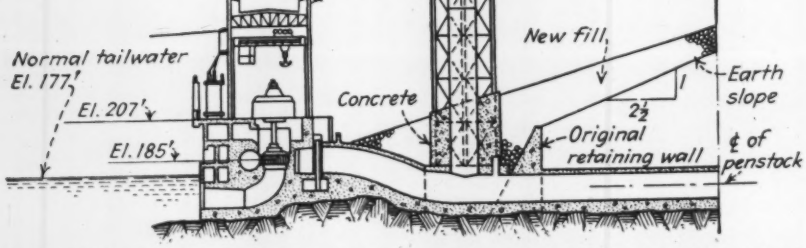


Fig. 4. At the powerhouse, the surge tank towers were encased in concrete to above the surface of the new rockfill and protection was provided against higher tailwater than anticipated in the original design.

The incremental cost of spillway capacity was relatively high because the existing channel could not accommodate the hypothetical discharge without substantial increase in its cross-section, involving principally rock excavation. The large surcharge storage offered an opportunity to materially reduce the necessary momentary discharge capacity by a slight increase in the allowable maximum water elevation. An economic balance was reached by combining a 3-ft. increase to the original height of the dam with an installation of two additional tainter gates, each 44 ft. wide, with sills 30 ft. below normal full pond level.

It was realized that loose rock would be the most desirable material for stabilizing the downstream portion of the dam, also that rock excavated from the spillway channel, and available for merely the cost of hauling, would be cheaper than any other material. A comparison of the volume of necessary rock excavation with that of the rock blanket required to raise the theoretical factor of safety of the dam to a satisfactory figure showed close agreement.

Changes at the power house

The additional spillway discharge due to the added gates will result in a rise of the tailwater, making it necessary to provide against flooding of the power house. Access to the building was originally at the turbine floor only. Designs were prepared for a new entrance at the generator floor level, and for closing all lower doors and windows either with reinforced concrete or with watertight removable bulkheads.

Some of the walls required reinforcement, and a large area of floor had to be torn up and replaced with a concrete mat 6 ft. thick to provide enough weight to counterbalance the pressure resulting from the maximum water level presumed possible outside the building. All construction joints in new concrete were equipped with copper water seals, and those between new and old concrete were provided with grooves that could be caulked with oakum or other suitable material.

Directly behind the power house the original earth slope terminates at a 35-ft. retaining wall, through which extend the four concrete-encased steel penstocks and concrete-arch culvert, previously mentioned. Between this wall and the power house, two of the penstocks are equipped with surge tanks, each supported on six steel columns. It was found that the required rock blanket would cover the top of the retaining wall to a depth of 25 ft. and would be 40 ft. above the surge tank column bases. Also, it would cover the mouth of the arch culvert with 60 ft. of rock, making it very difficult to install the two additional penstocks as planned.

Fig. 5. To simplify placing the new rockfill, terracing of the new work was authorized. Some earth was added at the top of the dam, as shown at the right.

The economical solution of this problem proved to be extension of the culvert until it ran out beyond the new slope, and encasement of the riser and columns of each surge tank in a hexagonal block of concrete up to the line of the new slope. The stability of these blocks is sufficient to withstand any horizontal load that can be brought against them by the rock fill.

Contract let for improvements

In October, 1943, a general contract was awarded the A. I. Savin Construction Co. of East Hartford, Conn., for all excavation and concrete work except the flood protection at the power house. The contractor sublet the concrete to the C. Y. Thomason Co., Greenwood, S. C., and brought to the site for his own use equipment for moving some 100,000 cu. yd. of earth and 500,000 cu. yd. of rock. This included three stationary electrically driven compressors of 850 cu. ft. per minute capacity each, eleven wagon drills, three power shovels with 1¾ cu. yd. dippers, one crane with 70-ft. boom and clam-shell and dragline buckets, three D-8 bulldozers, 20 motor trucks capable of handling 4 cu. yd. of rock per load, and five half-track trucks of considerably larger capacity. The latter were quite necessary on wet ground, and were useful in wet weather when the work would otherwise have been tied up completely. Owing to the nature of the soil, a very small amount of rain sufficed to make the roads too slippery for ordinary motor traffic.

The average quantity of rock excavated and placed with this equipment, per month of 234 working hours, was about 41,000 cu. yd., with a maximum of 51,000 cu. yd. The average haul was about one mile.

Several different types of rock were present in the spillway channel, varying from hard granite to soft mica schist. No limitations were placed on the material for the rock blanket, other than that it should be hard enough not to pulverize in handling and should contain not more than 10 percent of earth. Constant inspection was maintained to see that all loads unsuitable for the dam were dumped in spoil banks.

The contractor was at first given an option whether to grade the material placed on the dam to the theoretical slope lines or to deposit it in a series of 5-ft. terraces, keeping each accurately to its proper elevation and straight enough to present a satisfactory appearance. As the slopes were sufficiently gradual for running a bulldozer up and down them, he chose the former. However, after he had placed in this way several thousand cubic yards of rock which happened to be one of the softer types, it became evident that this method would not be satisfactory. The rock was so completely pulverized as to have the appearance of earth. To reduce the

amount of handling after dumping, five-foot terraces were then tried.

The final result was much better, but difficulties were encountered in routing the trucks. The berms at the higher elevations, where the theoretical slope was steeper, were too narrow to act as roads for truck traffic, and excavation required for turnouts was excessive. Therefore, it was decided that, for practical reasons, the height of the terraces should be 10 ft.

Although the rock was paid for as excavation, the quantity necessary depended partly on the space it occupied in its loose state when dumped on the slope of the dam. This caused a good deal of speculation as to what void ratio might be expected in such material, consisting of large rocks in contact, with interstices well filled with fine material, including some earth.

Upon completion of the work, the volume of all the excavated rock in its final location was measured or estimated as closely as possible, including that used for concrete aggregate, and for miscellaneous other purposes, and that discarded in spoil banks. Results indicated an apparent swell or void ratio of 21 percent. This figure was unexpectedly low and led to the thought that the rock load on the dam might have caused enough additional consolidation of the earth to add appreciably to the fill required for reaching the specified elevations.

As to this possibility, it can be said that the survey showed the berms to be 0.2 to 0.5 ft. low at many points, but there is no other evidence of settlement, and it is hard to conceive that the increase in volume of fill from this cause could be sufficient to raise the void ratio more than 2 or 3 percent.

Development of vertical cracks

The dam crest carries a state highway, temporarily surfaced during the original construction with a bituminous penetration course of crushed stone on a soil base, with the intention of laying a concrete pavement later. The process of consolidation which took place mainly during the first seven or eight years caused a number of cracks to open in the bituminous pavement, extending in some cases to a depth of 20 ft. or more into the earthfill. The pavement was promptly repaired on each occasion, but no attempt was made to completely fill the cracks, and it was thought that some of them might have remained open. It was believed possible, also, that in the course of settlement, voids might have been left between the puddled core of the dam and the rolled fill which was placed on top of it when the embankment became too narrow for continuing the use of the segregation pool.

Voids located and filled

Investigation of the original rolled earth fill at the top of the dam for the presence of such large voids was made before placing the additional earth fill. The apparatus consisted of a rotary drilling rig arranged to allow the rod to drop freely of its own weight, and a paddle grout mixer discharging under air pressure through a hose direct to the drill hole casing. A fishtail bit was used, with water supplied through the drill rod under 30 psi.

In starting a hole, five feet of 2½-in. casing was first driven into the earth. The hole was then drilled through the casing and 5 ft. ahead of it, after which another 5 ft. of casing was driven and the operation repeated. Drilling was continued until wash water ceased to come out of the casing, or until the hole penetrated the puddled core of the dam, or was abandoned for some other reason. Where the wash water was lost, all the casing was left in place until the hole was grouted.

Each batch of grout consisted of three cubic feet of fine sand and one cubic foot of sifted clay, except for the first batch in each hole, which was mixed two to one. Sufficient water was used to make a free-flowing but not soupy material. Air pressure started at 30 psi. but quickly dropped 5 or 10 lb. Feeding of grout was continued until it appeared at the surface, usually several feet from the casing.

In a large majority of the holes put down, a point was reached where the wash water was entirely lost, and grout was applied as above described, in amounts varying from 2 to 37 cu. ft. per hole. In order to find where the grout was going, a number of test pits were dug. Where pits were located over or adjacent to grouted holes, the grout was discovered to have penetrated a longitudinal crevice, approximately parallel to the axis of the dam, to a distance of 3 to 9 ft. from the hole. The crevices extended no farther than the grout. In pits not close to holes, no crevices were found.

From these observations it was concluded that the crevices were due to the removal of material by the wash water from planes of weakness, which might be attributed to a state of tension in the embankment soil or might be shear planes resulting from settlement of the rolled fill following shrinkage of the puddled core. Since these planes, extending longitudinally, could not start piping through the dam in case of very high water, and were not a source of danger, the work was continued only far enough to give assurance that the conditions found were typical of the entire dam.

Before the additional fill was placed the bituminous pavement was removed and the shoulders and downstream slope stripped of sod and any other objectionable material. Since the original upstream slope was covered with riprap, the removal of which would have been expensive, all fill on that side was made with rock.

The earth surface on the crest and downstream slope was scarified, then thoroughly compacted with sheepsfoot rollers. Earth was spread in layers, not more than 8 in. thick after rolling, compacted by at least six passes of a sheepsfoot roller with tamper feet projecting 7 in. and designed to produce a pressure of not less than 400 lb. per sq. in. on the combined area of a single row of feet.

The subgrade for the concrete pavement then was completed and the pavement was laid at once.

Design and supervision

The general requirements and principle features of these improvements were determined by Joel D. Justin, consulting engineer, of Philadelphia and Gilbert Associates, Inc., of Reading, Pa., representing the owner, the South Carolina Electric and Gas Co., in conjunction with engineers of the Federal Power Commission and Corps of Engineers, U. S. Army. All detail designs, drawings and field supervision were by Gilbert Associates, Inc., which, with its predecessor, W. S. Barstow & Co., has been closely associated with the Saluda development since the preliminary surveys of 1926. The Federal Power Commission was represented in the field by the division engineer, South Atlantic Division, War Department, Atlanta, Ga., and the district engineer at Charleston, members of whose staffs were in constant touch with the work.

Wagon Drills Mounted on Trucks as Jumbos

The versatile wagon drill was used to good advantage in excavating 650,000 cu. yd. of rock in the enlargement of the spillway at Saluda Dam in South Carolina as part of the work described in the preceding article. In addition to drilling all down and low horizontal blast holes with these units, the contractor hit upon the plan of mounting a pair of wagon drills on special high decks of two half-track trucks as a drill jumbo for high horizontal holes. From these carriages, which put the drills 14 ft. above the ground, an adequate drilling pattern was worked out for blasting vertical faces as high as 35 ft.

The spillway enlargement included increasing the length of the spillway opening and widening out the long narrow valley of the old spillway channel. Overburden, which runs fairly light, was removed by either sidecasting with a crane and clamshell or shovel loaded into trucks. The rock varied from a soft mica schist to a very hard granite gneiss.

Half-track drill jumbos

As both down and horizontal drilling is required for excavating the hard rock, some kind of staging was necessary for the drills to reach the high horizontal holes in the deep cuts. Because of the length of cuts, a drill carriage was the logical setup, and with half-track trucks (crawler treads in the rear) available from the haulage fleet, the answer to the staging problem was obvious.

Two jumbos were made by placing a horizontal welded frame of heavy pipe across the body tops of two half-track trucks. These frames extended well beyond the sides and rear of the truck bodies to provide ample workin space. A timber deck, protected wit side guard rails, formed the workin platform, and a timber canopy over th truck cab prevented damage to the ca roof from the long drill steel.

Each platform was wide enough t accommodate two wagon drills side b side in drilling position. Rather tha bother with an air line manifold o the carriages, the contractor hooke up an independent air hose to eac drill leading from a main supply lin manifold on the ground.

The half-tracks made an ideal dril carriage, for their substantial rea crawler treads eliminated the vibratio and surging found so troublesome i adapting all-pneumatic tired trucks a jumbos. No blocking was required, an the half-tracks were quickly placed i drilling position against the face.

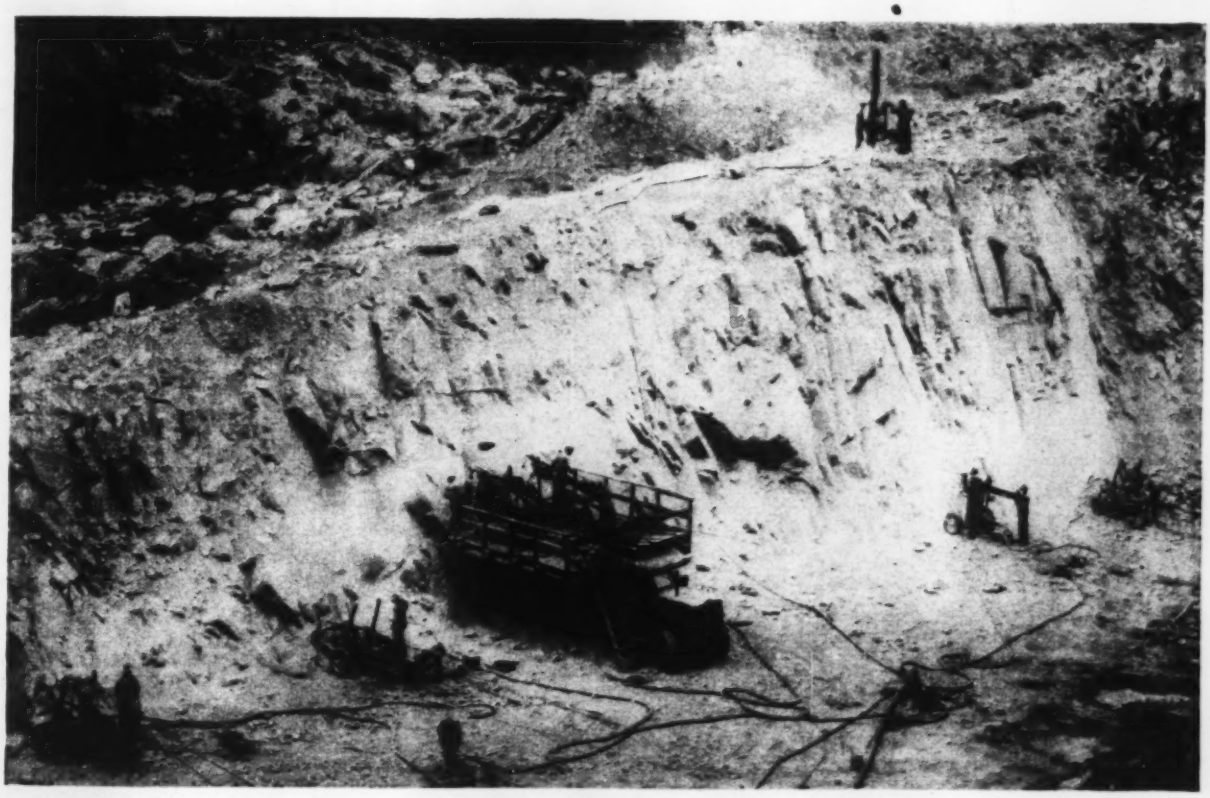


Fig. 1. Wagon drills were mounted on half-track trucks that served as drill jumbos at Saluda Dam. Face drilling was supplemented with one row of down holes in hard rock.

Drilling procedure on the hard rock section was to drill a horizontal row of 22-ft. holes from the jumbos, with the starters cutting the face 14 ft. above the ground. Two more rows of corresponding depth were drilled by wagon drills on the ground at levels about 2 and 7 ft. above the base. In the upper two rows alternate holes were sloped upward from the face which, in combination with the spacing of starters, gave a pattern of holes spaced 5 ft. apart each way at the back end.

The face round was supplemented with a row of down hole kickers drilled from on top on a line 24 ft. back of the rim. These holes, spaced 4 to 5 ft. apart, were bottomed at the level of the lowest row of face drilling.

Powder charges, of course, vary with the depth of cut and rock conditions, but the usual load was 10 to 12 lb. in each down hole and from 3 to 4 lb. in the high face holes, increasing to 15 lb. in the bottom row. All powder used in the hard rock was 60 percent ammonia gelatin.

For firing, the loads were hooked up in series of 30 holes, each being connected by heavy lead wires to a 220-volt firing line. Several series were fired together as one shot. This procedure resulted in a yield of about 1.7 cu. yd. of rock per lb. of powder, considered highly satisfactory for this type of ground. Some additional blockholing was necessary to break pieces sufficiently small to permit loading the rock into trucks.

As the softer mica schist breaks well with light shooting, the drilling in this material was limited to down holes. Eight rows of holes parallel to the face and from 4 to 7 ft. apart in both directions, were sunk 18 ft. deep with wagon drills. Light powder charges, from 1 to 3 sticks of 40 percent gelatin, were sufficient to loosen and break down the rock to loading size. Deep cuts were benched down.

Fig. 3. Shovels loading into dump trucks and half tracks removed spoil from spillway enlargement excavation. The overburned was cast aside by crane and clamshell.

A rock disposal outfit of three 1¾-yd. shovels, twenty-four 6-yd. dump trucks and five 10-yd. half-track trucks has averaged about 41,000 cu. yd. per month. Hard rock was hauled approximately a mile as blanket for the downstream face of the dam, while the remainder was wasted in dumps almost as far away.

Saluda Dam is owned and operated by South Carolina Electric and Gas Co. W. H. Kendrick represents the utility company on the project. Joel D. Justin, consulting engineer of Philadelphia, and Gilbert Associates, Inc., of Reading, Pa., were consultants on the work.

A. I. Savin Construction Co., East Hartford, Conn., did the spillway enlarging as part of a general contract for improvements to the dam. Lloyd F. McCarthy was general superintendent for this firm. For the U. S. Army Engineers, which represented the Federal Power Commission on the project, Joseph Hollowell was resident inspector.

Fig. 2. Soft mica schist was excavated by benching method. Light shots in wagon drilled downholes were sufficient to break up the soft rock.

Closing Breaks in Tidal Levees

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Consulting Engineer, San Francisco, Calif.

***Contents in Brief**—A highly effective method of closing breaks in levees on tidal rivers, developed by the author as the result of long experience in repairing such breaks, employs the reversing tidal flow through the break to build up shoals that reduce the opening and simplify complete closure.*

COSTLY FAILURES have resulted from attempts to close deep breaks in levees that restrain waters in which the direction of flow reverses with tidal changes. Knowledge of factors that govern deposition under these conditions is essential to success in the delta region of the Sacramento-San Joaquin rivers where more than 1,000 miles of levees in about 100 separate units protects some 475,000 acres of reclaimed low land. Methods developed to meet conditions in this delta are described in the following.

Soil in this delta region consists of highly fertile material washed down from the two great valleys of California, the Sacramento and the San Joaquin, and has been further enriched by the remains of marsh growth. This land is so productive that practically all of it has been reclaimed and has been cultivated for many years. Water for irrigation is delivered by pumps to the higher areas and in the lower part of the delta, where the land surface is 1 to 10 ft. below tide-water level, water for irrigation is brought in by siphons.

It should be explained that, although subjected to the effect of tides, water passing the levees on the outer side is not sea water but rather fresh river water whose flow toward the sea is not only checked but is actually reversed by the tidal changes in San Francisco Bay, into which the streams discharge. The volume of flow in the rivers is sufficient to keep the water fresh enough to be satisfactory for irrigation.

A break in a levee in this delta region could flood to a 10-ft. depth an area of several thousand acres. The tidal ebb and flow through such a break would wash the usual foundation material to a depth of 30 to 50 ft. and the break could widen to several hundred feet. The procedure here outlined for closing a typical break of this sort does not describe any particular case but rather indicates general procedure applicable to all such breaks.

After a levee is breached it is usual for the area through which the flood waters are flowing to increase rapidly. Although some erosion continues for a longer time, the rapid increase lasts for only a few days. The first move toward repair is to establish two tide gages at convenient points near the break. One must be on the outer (river) side of the levee and the other on the inside (reclaimed area). Readings from these gages over even a short period, in connection with published tide tables for the vicinity, will provide data for drawing curves indicating the schedule of tidal flows through the break. The reconstruction program must then be worked out to conform to and be governed strictly by the time and tide schedule.

Slack water determination

By plotting the curve of inside tidal action against that for the tidal effects outside the points of intersection will indicate slack water in the break. This slack water lasts only a few minutes before the current reverses. If the cross-section of the break increases, the inside curve approaches the extremes of the outside curve. The approximate head, creating various velocities in and out through the break at any given time, is indicated by the curves.

The next step is sounding the break at slack water to determine proper location for the pile structure. As a rule the center line of the piling should be a little inside the line followed by the old levee crown. A profile of the break along this center line is needed before a bill of materials can be made up for the work to be done.

Usually, the best plan is to drive the piles in two rows about 6 ft. center to center both ways. These piles must have waling and cross ties. These horizontal supports can be made from piles if squared timber is not available.

Double row of piles

Thus the initial structure is to consist of a double row of piles located on a line determined by soundings. The piles are driven by commencing at the ends of the break and working toward the center during times of slack water or moderate velocity through the break. The tidal diagram already mentioned will indicate the approximate time and tide velocity to be expected. As piles are put in, they must be securely fastened by waling before being left exposed to swift currents. In currents of high velocity, individual piles not properly secured may vibrate, work loose and wash away.

After the piles are driven and braced by waling and cross ties, the result is at best a flimsy structure, especially in deep water. The piles have reduced by about 20 percent the area through the break and this means that erosion is liable to increase. With this in mind, rock should be on hand ready to be thrown around the piles.

The next operation is the placing of brush bundles or facines made of willows which grow in plentiful supply throughout the delta. The brush is cut, laid parallel and tied with baling wire into bundles about 1 ft. in diameter and 15 ft. long. Particular care must be used in placing the first of these facines. Several groupings of facines, loaded with rock, are first sunk to protect the ends of the break; deep cuts must be filled to even up the bottom and, finally, a continuous core of brush is built up a few feet above the bottom across the break.

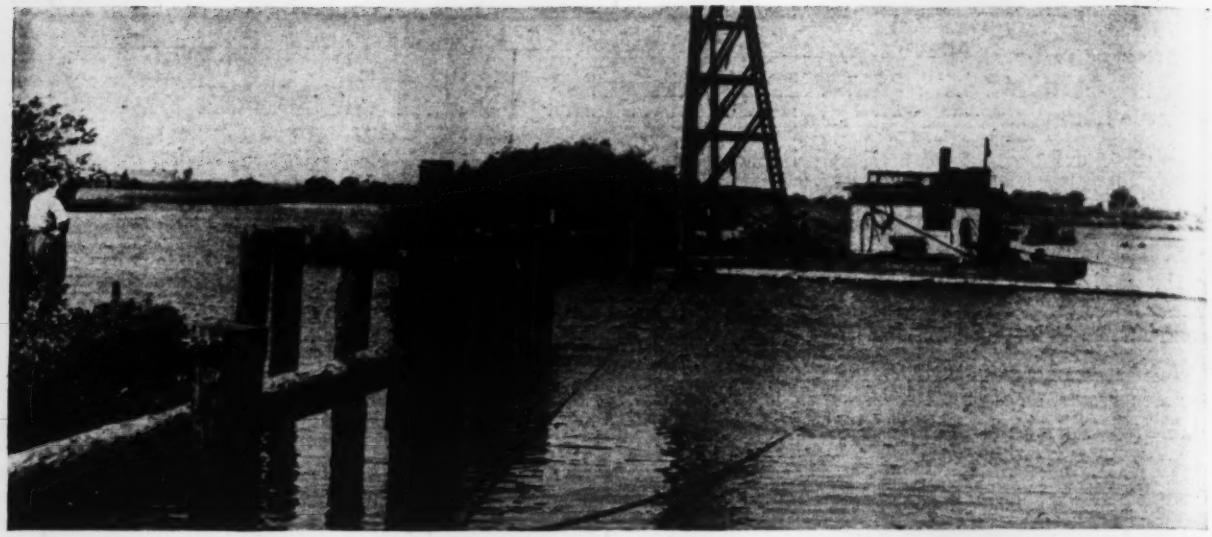

Fig. 1. First construction operation in a typical break closure is the driving of piles somewhat inside the levee center line. This break, shown at slack water, is 200 ft. wide and 40 to 50 ft. deep.

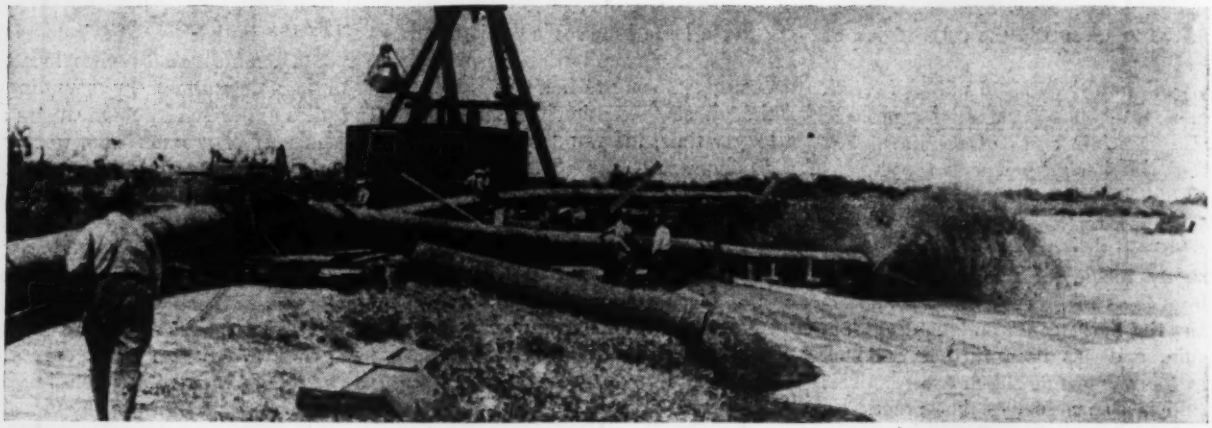

Fig. 2. Ten days later, after brush facines are in place, and have been anchored with rock, dredged material is pumped in and is spread by splash boards.

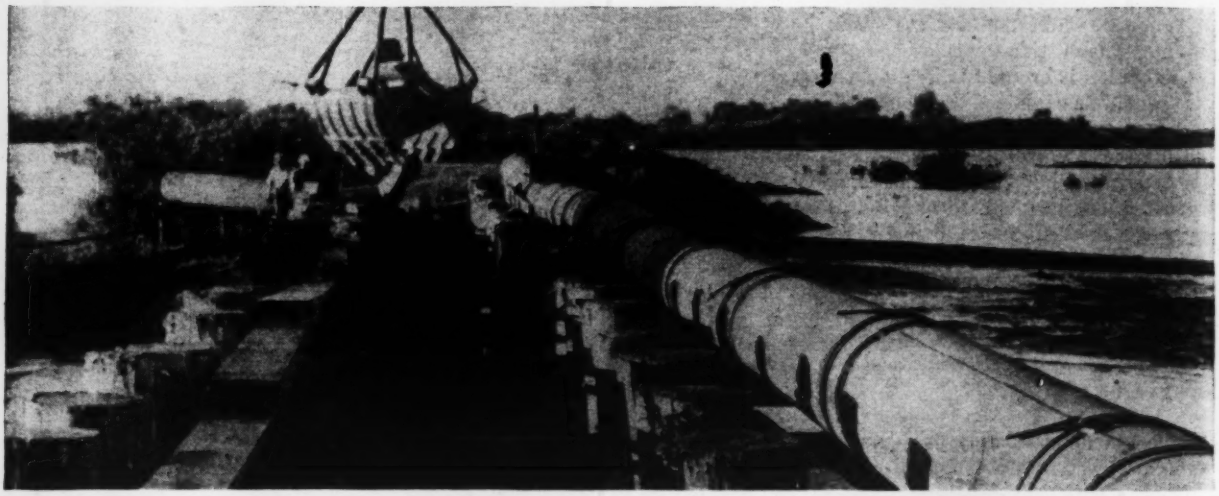

Fig. 3. Sixteen days later, facines (now built up to a higher level) are being weighted down with rock. Dredge pipe (26-in. dia.) can discharge on either side. Closure of this break was made the day this picture was taken.

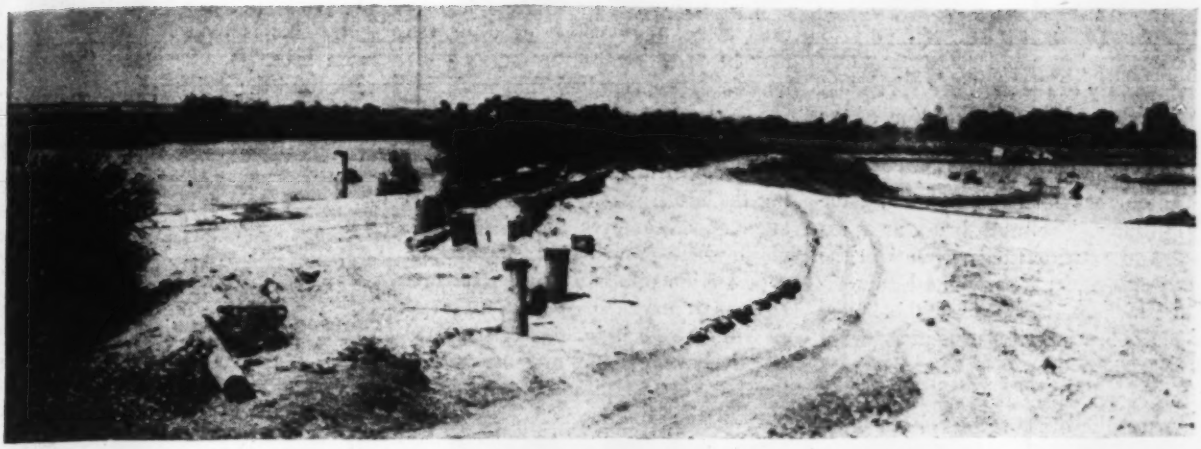

Fig. 4. After closing the break, a sand cover has been built up around the pile structure. As here shown, the level of water inside the levee had been pumped down several feet.

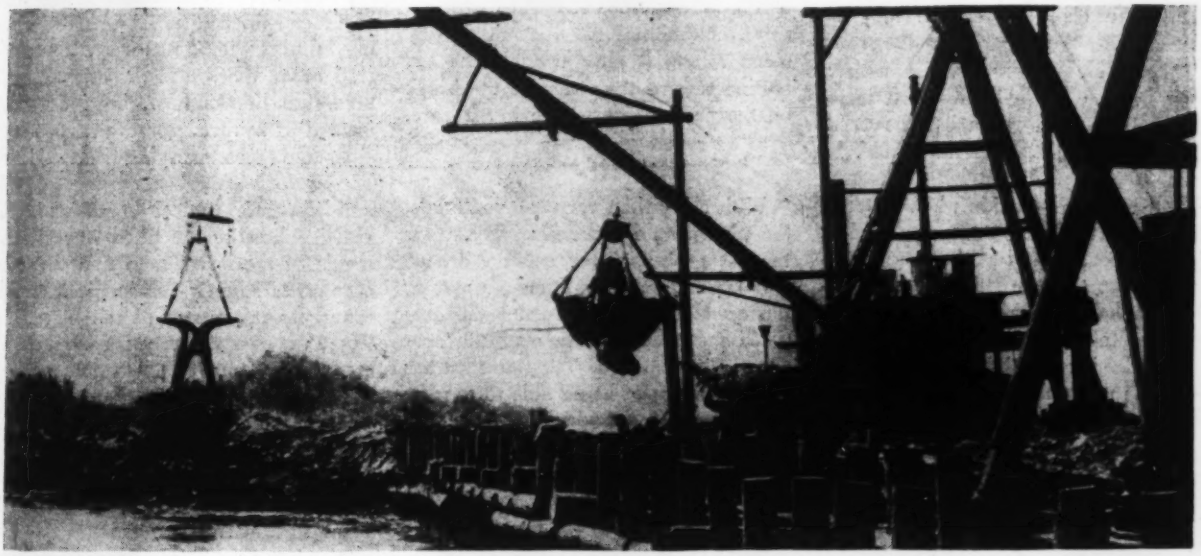

Fig. 5. Piling in place across another break. Note men carrying facines. A derrick barge is delivering rock on the brush core, and at the left a 5-cu. yd. bucket on a 225-ft. boom places soft material whence it can creep down along the bottom.

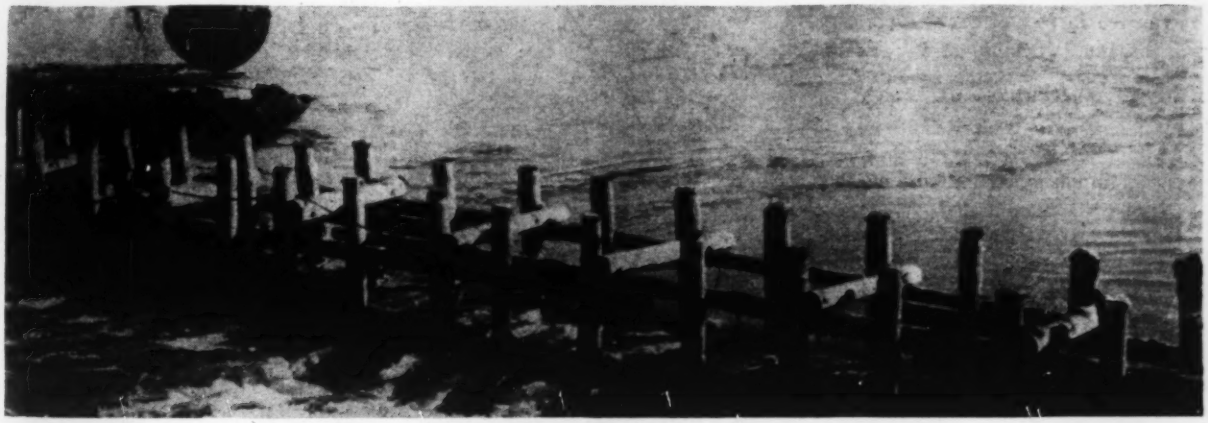

Fig. 6. Heavy outward flow in the same break shown in Fig. 5 after the pile structure had been reinforced by considerable shoaling. Shoaling accounts for the ability of the structure to withstand the head indicated.

This core should then be given a generous paving of rock not only to anchor the brush but also to increase the stability of the structure. It should be understood that the function of the pile structure is not to withstand considerable pressure but simply to act as a guide for placing and holding the brush mats. Too much brush area, exposed to extreme tidal currents in the early stages, could cause head differential which might demolish the inadequately braced pile structure.

Mats influence shoaling

After the first facines have been sunk to place all the way across the break, as described, the placing of material in the shoaling process is begun. For this purpose, either a suction or a clamshell dredge may be used. With the suction dredge, sand is preferable material, while with a long boom clamshell only such material as is within reach can be used. In any case, the material should be properly placed inside when water is flowing out and outside when water is flowing in through the break. It must be so deposited and at the proper distance from the pile structure, depending on the velocity of the current, as to allow the material to reach the bottom in front of the brush mats. Otherwise the material would wash through and be scattered.

This dredged material, properly placed, fills the brush core between the piles and shoals up on either side. This shoaling raises the fill as more facines are added. I have called this process "focal shoaling" in contrast with scatter shoaling which would result if the current is not used as here described to carry the material to where it will be effective in supporting the core.

This method of break closing is thus seen to commence at the bottom and build up across the break. The shoaling process strengthens the pile structure as the filling proceeds. Facines are sunk continuously, depending on the condition of the fill. The brush goes down between the rows of piling and so long as the current is flowing the friction tends to hold the accumulation of brush against the piles. At slack water, however, the brush slowly settles to the bottom without upsetting its load of rock. It is important that more rock be thrown in to insure proper anchorage as the brush core is built up from the bottom.

In cases where a suction dredge is used alone, four points of discharge may be provided, one inside and one outside at each end of the break. It is necessary to place these discharges so that sand will flow into the current and settle to the bottom before reaching the brush core. The current thus automatically moves material to the place where it will best support the combination pile and brush structure.

The soft muck deposited by the clamshell when velocity is high can be used effectively only at the extreme ends of the break. The place to put this is outside when the tide is flowing in and inside when the tide is flowing out. Placement must be in such manner that the material accumulates above water level and hence where it is out of the current. From a surcharge on soft foundation built up in this way there will be a slow creep along the bottom toward the center of the break on the proper side of the brush core.

Clamshell has advantages

With other than very soft materials, the placement by clamshell is similar to that described for suction dredge deliveries except that at slack water or during slow flow the clamshell may place material directly over the spot where it is required. The clamshell has the advantage of being able to quickly change points of delivery. This is overshadowed in case of material scarcity by the advantage of the suction dredge in delivering superior selected material—always available from some distance.

The suction dredge method here described was used on the last important break closure in the delta region. This was the first time pumped material was used with the focal shoaling method. As suction and clamshell dredges may both be used at the same time without interference, a combination of their advantages should be considered in planning important break closures.

The information gained from soundings at each slack water as the work advances shows where the next brush should be sunk. When the pile structure is strengthened by sufficient shoaling, more extensive accumulations of brush may be used, eventually reaching practically across the break. Such mats are best made by floating facines between the piles on a rising tide; the brush being properly placed by breaking joints to make a tight continuous mat. This is then loaded with rock, more brush is added and then more rock until the weight of the accumulation and the slackening of the tidal current results in the settling already mentioned.

Closing the break

As the core is built up in this way, the shoaling process likewise continues and the volume of tidal flow in and out gradually diminishes. As a result, the inside tidal curve flattens at about the average tidal elevation and gradually rises as shoaling proceeds, depending upon tidal conditions. When the break is finally closed, the water captured inside the levee remains at a level somewhat above that of a mean tide. Records of break closing failures extending over a long period reveal that, in practically all failures, the breaks have been outward instead of inward.

In the accompanying illustrations, Figs. 1 to 4 are all of the same break and illustrate typical conditions. In Fig. 1, showing the piledriver on the inside of the levee, note that the row of piles is slightly inside the line followed by the crown of the levee. In Fig. 2 the derrick barge is shown delivering rock from an unseen barge.

Fig. 3 shows the process of building up, between the piles, the brush accumulation which slowly settles to the bottom in slack water if not loaded down with rock sufficiently to sink it prior to that time. Where the pipe is put across the top of the piles as here shown, final deposition of material in the fill after closure is accomplished by discharging from holes in the bottom of the pipe. This quickly builds up sand cover around top of the pile structure.

Figs. 5 and 6 show the clamshell mehod of supply and placing material. If favorable material or sand is within reach of the clamshell bucket, it is placed for focal shoaling during heavy flow, the same as described for suction dredge delivery. Soft mucky material, on the other hand, must be placed at ends of the break as shown during heavy flow, so as to creep down along the bottom. The derrick barge delivers rock which serves to sink brush being placed between piles. This builds up the brush core which finally becomes impregnated with dredged material as shoaling continues.

Graving Dock Lined With Shotcrete

W. H. R. Nimmo
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***Contents in Brief**—Wartime scarcity of men and equipment in Australia necessitated many improvisations in constructing the Brisbane graving dock. Impervious sandstone greatly simplified lining requirements; pumping plant was assembled largely from salvaged equipment.*

BY EXCAVATING in a sandstone knoll it was possible to build a quickly needed graving dock at Brisbane, Australia, without a cofferdam and with only surface protection over the sandstone for the permanent walls of the structure. Coupled with salvage of mechanical equipment from scrap, construction of the dock was accomplished with a minimum of critical material and a small amount of labor.

The dock is 110 ft. wide and 830 ft. long at sill level, inside the inner sill. It was designed to accommodate vessels up to 770 ft. long, with space allowed to remove tail shafts. Sills are at El.—30, the floor of the dock at El.—34, and top of the coping at El. + 17, above extreme low water. Maximum tide range is about 7 ft.

Sandstone simplified construction

The sandstone knoll rises 25 ft. above low water. The formation is a comparatively soft, friable sandstone that varies in texture from fine to coarse and has a dip of about 5 deg. transversely across the dock toward the river. This formation can be trimmed with a pick but explosives are necessary for its economical excavation. The rock in place has ample bearing power to sustain heavy loads and possesses considerable cohesion, although it has little strength in shear as shown by the fact that small pieces can be crumbled in the hand.

In addition to its high bearing value this sandstone is unusually watertight. Cylindrical specimens 12¼ in. in diameter by 9 in. thick showed permeability coefficients ranging from 500×10^{-12} to $15{,}000\times10^{-12}$ sec. ft. per sq. ft. under a pressure gradient of 1 ft. per ft.

As the lower of these values is comparable to that for good concrete the location was considered excellent in this respect. Tests indicated that voids range from 5.7 to 7.7 percent of the volume. Confirmation of the impermeability appeared in the fact that although excavation at the entrance to the dock was only 40 ft. from the river, pumping during construction was unnecessary except for removal of rain.

Danger from water pressure

The greatest danger to the dock walls was believed to be from internal water pressure that might develop if the dock were allowed to stand full for some time and were then emptied rapidly. However, tensile strength tests indicated that failure of the walls was unlikely. It was decided that the side walls would require only such protection as could be given by a layer of shotcrete applied over the trimmed wall of the excavation.

This program was carried out with a sprayed-on layer of shotcrete ranging from ¼ to ½ in. thick. The mix consisted of two parts Brisbane River sand, which passed a ⅛-in. screen, and had a fineness modulus of 2.8; two parts of pit sand, fineness modulus 1.5; and one part portland cement. Sand was dried on hot plates before use. After several months of use the shotcrete has been observed to flake off only in a few small patches usually near coping level where water may have gotten behind the shotcrete or where there may have been some clay in the formation. Whether slow deterioration of the sandstone will ultimately necessitate building a continuous concrete lining remains to be seen.

At present there is no indication of that probability. Use of the shotcrete lining instead of concrete walls of ordinary thickness made it possible to build the dock with only 31,000 cu. yd. of concrete.

Fig. 1. Dock interior as seen from cofferdam in access channel. At right, the caisson for closure of dock is being assembled under crane on a temporary mounting.

With cement, aggregate and reinforcing steel classed as critical materials, continuous walls on the sides of the dock were limited to the entrance and to two places where the sandstone appeared to need protection. Elsewhere, concrete altar piers 3½ ft. thick and spaced at 20-ft. centers were built along the sides of the excavation as shown in the accompanying illustrations. The sandstone exposed between these piers has only the shotcrete coating to protect it from weather and to prevent raveling.

At the top of the altar piers, a reinforced concrete beam on each side of the dock carries the crane rails. Altars between the piers consist of hardwood planks surfaced with bitumen and fine screenings to prevent them from becoming slippery. Shores are placed only against the concrete piers.

Two sills are provided, one 50 ft. from the other, thus providing (1) accommodation for a longer vessel than otherwise and (2) means whereby, in an emergency, the regular or inner sill could be made accessible in the dry. The inner sill is made in the form of a slot, designed for pressure in either direction, so that water in the dock can be retained at higher level than in the river if need arise.

Granite blocks are used for lining the inner face of the slot sill which is the face most used. The outer face of the slot, which will be only rarely used, is made of concrete; the outer sill is granite lined.

All granite facing blocks were worked to final dimensions and finished in the stonemason's yard, after which they were carefully set by the use of timber shear-legs, thus saving the time that would have been entailed in slowly dressing the faces after the blocks were in place. The faces upon which the caisson bears were fine axed. This method proved to be quite satisfactory and final rubbing down was necessary on only a few joints where high spots were found.

Water passes from the dock to the pumps through two 7.5-ft. square openings, protected by gratings, one close to each side wall and about one-third the dock length inshore from the inner sill. These openings lead to a culvert that runs transversely under the dock and into the pump suction chamber. From the pumps the discharge is directly into shallow water at the river bank.

The pumping plant is in a well whose diameter, inside the reinforced concrete lining, is 46 ft. This pump well can be isolated from the dock by a timber gate that seats against a granite lined face. To minimize the intake of silt, water for filling the dock is drawn from the deep access channel by two 6½×5-ft. culverts incorporated in the side walls of the entrance structure. These culverts are controlled by electrically operated slide gates.

The concrete floor of the dock is 6 ft. thick for a width of 8 ft. on the center line. The remainder of the floor is 2 ft. thick laid in sections 20 ft. square. To relieve possible uplift pressure gravel drains under each slab lead to a 2-in. vertical vent at the center of each slab.

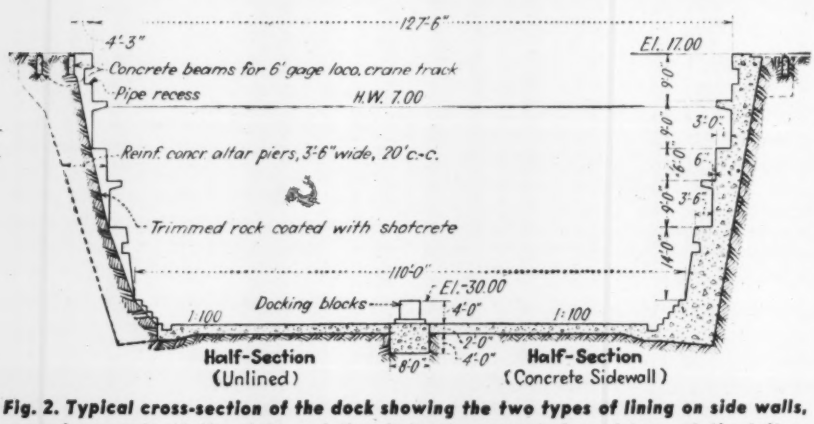

Fig. 2. Typical cross-section of the dock showing the two types of lining on side walls, poured concrete at the right and the shotcrete protected sandstone at the left.

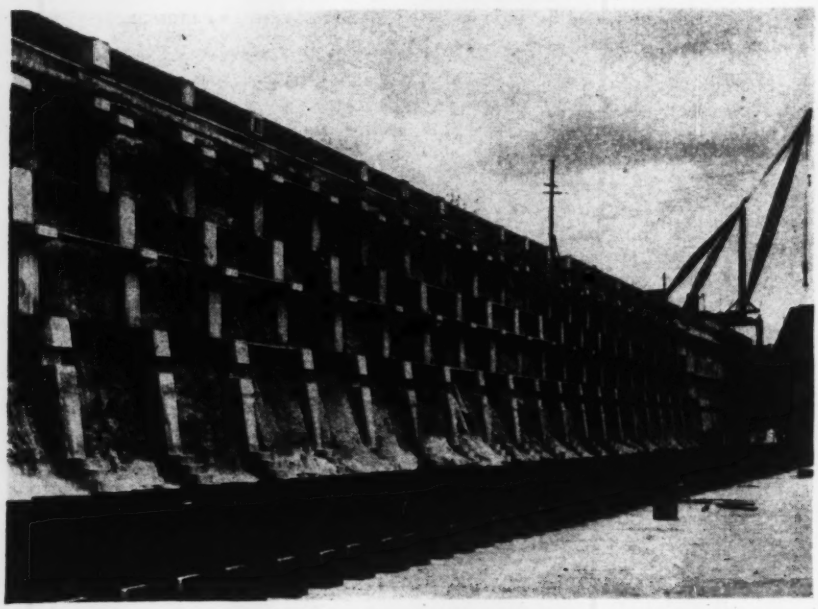

Fig. 3. Unlined side wall after completion of altar piers between which sandstone has been covered with shotcrete. Horizontal slot below lowest line of planks is for a 9-in. main to supply circulating water. In foreground are keel blocks on dock center line.

Assembly of the pumping plant

The plant necessary to remove the 30,000,000 gal. of water that has to be pumped out of the dock each time it is used presented a major problem. The entire output of the country's workshops when the dock was being built was required for urgent defense needs. The menace was serious because the Japs were streaming across the Owen Stanley Mountain Range in New Guinea toward Port Moresby just opposite the northern tip of Australia. No priority could be obtained for large pumps or electric motors.

This part of the problem was solved when someone remembered a 2,000-hp. triple expansion marine engine and a 30-in. sand pump in the old dredge "Hercules," which had been laid up by the Harbors and Marine Dept. some 30 yr. before. The old engine was cleaned up and reconditioned, a new impeller was fitted on the pump shaft, the outlet section of the casing was reconstructed and the reassembled unit was installed in the pump well. Here it functioned quite as well as when new. However, such a plant required a large amount of steam and no boilers were readily available.

Two boilers were salvaged from the hulk of the dredge itself and a search of abandoned mines resulted in the discovery of two other boilers. Originally they had been removed from the battle cruiser "Australia," which was sunk after the last war under terms of the Washington Treaty. These boilers were retubed and a reinforced concrete smokestack was built since a steel stack was taboo. A feed water pump was found in a junk dealer's yard.

All this pumping equipment still required some means of keeping circulating water in motion. A small steam engine was obtained from the water department of a town that had changed over to electric drive and a centrifugal pump was obtained from another source. Pump and engine were designed for direct connection but being made by different firms they had opposite rotations. This difficulty was overcome by placing them side by side and connecting them with a chain drive. Two 15-in. electrically driven centrifugal pumps of stock pattern were installed to assist in final unwatering of the dock.

The installation of the boilers has the advantage that steam can be supplied to ships in dock. Other services available to ships in dock are compressed air, fresh and salt water, high pressure fire services, circulating water from a 9-in. salt water main and electrical power at 220 and 110 volts d.c. and at 415 volts, 3-phase, 50-cycle a.c.

Caisson and accessories

The gate or floating caisson for closing the entrance to the dock is a steel structure built by Evans, Deakin & Co., shipbuilders of Brisbane, on which final assembly was made in the partially completed dock. The caisson is unwatered by four 8-in. motor-driven pumps. Four 3-ton mobile cranes, which also are used as towing locomotives in docking a ship, are part of the equipment as is a 40-ton stiff-leg steam derrick installed near the entrance to the dock for handling propellers, tail shafts or other heavy lifts. Keel blocks of hardwood surmounted by Queensland pine caps were secured by chains to anchor bars bedded in the concrete of the floor. Unlike other species, the Queensland pine is well suited to this service.

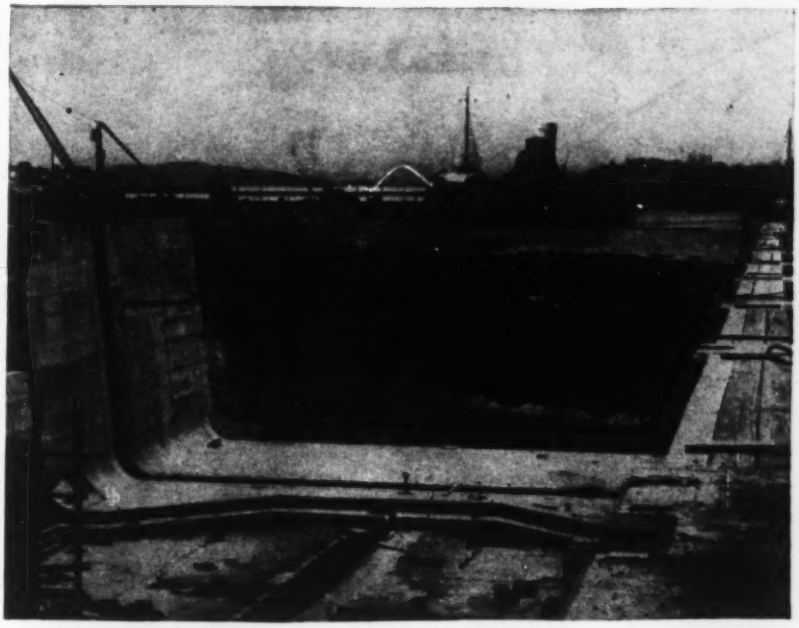

Fig. 4. Dock entrance structure, from inshore, before excavation of access channel. The rock formation is typical of that in the drydock area. Concrete shown at lower right is top of altar piers.

Progress and personnel

Work on the dock was started late in August, 1942, but after considerable progress the Army, acting under military necessity, suddenly seized the mobile plant. This necessitated renting, salvaging and reconditioning other equipment, most of it in a class that normally would have been left in the junk yard.

However, with this equipment the work was advanced and the dock was ready for filling by the end of 1943. Delay in deliveries of steel for the caisson and for dredging the entrance channel held up the work further and it was not until long after the originally estimated construction period that the job was finished. When the war in the Pacific ended, the dock had been in service for 14 months.

The work was carried out under the general direction of J. R. Kemp, state coordinator-general of public works and deputy director-general of allied works, through a board of engineers appointed by him. Members of this board were W. H. R. Nimmo, chief engineer, Stanley River Works Board, responsible for design and coordination of work; C. M. Calder, district engineer, Main Roads Commission, in charge of construction for the Main Roads Commission, which was the constructing authority; W. T. Evans, chief engineer, Harbors and Marine Dept., responsible for dredging and marine work; D. Fison, consulting engineer, Harbors and Marine Dept., who designed the caisson and approach wharf. Other members of the board were L. J. Price, chief engineer, city of Brisbane, and G. W. Watson, deputy coordinator-general of public works.

In Australia there is no dock constructing authority corresponding to the U. S. Navy's Bureau of Yards and Docks. Although collectively the team named in the foregoing had considerable experience in constructing various engineering works, the design and construction of docks was relatively new to them. However, decisions were made in consultation with the Royal Australian Navy, and in both design and construction the venture has been entirely successful.

Underwater Cutting and Welding Speeded and Simplified by Electric Arc Processes

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***Contents in Brief**—Using special equipment costing only $150, any diver can quickly learn to cut almost any metals under water using the arc-oxygen process with flux-coated tubular steel electrodes. Materials for cutting 1/2 in. thick steel cost about 25 cents per foot and speeds may average 30 ft. per hour under water. The same process can be used economically for hard-to-cut metals under normal conditions. Also, an underwater electric-arc technique and electrodes have been developed that are adaptable to welding mild steel under water.*

UNDERWATER CUTTING has been simplified by introduction of the arc-oxygen process to the point where the average local diver, using only a little special equipment and with only a few minutes' instruction can make rapid cuts on almost any metal, even under the most difficult diving conditions. And, while considerable training is necessary, underwater welding of mild steel can be done with very little special equipment and by any diver experienced in ordinary electric welding on the surface.

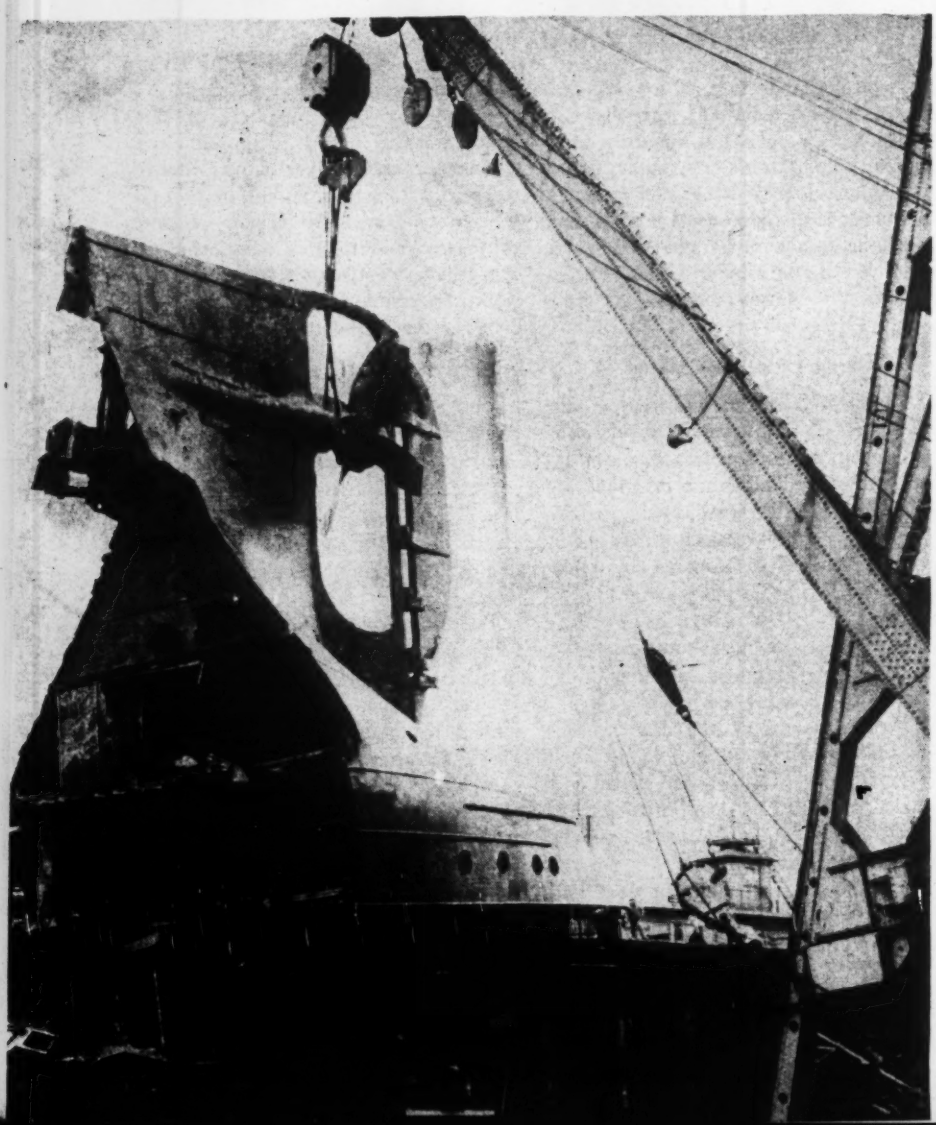

Fig. 1. Typical of cutting that has been done underwater by the arc-oxygen process is this section from a 385 ft. long vessel (ENR Dec. 14, 1944, vol. p. 771).

Contractors and engineers concerned with any work on or around water have used both gas and electric cutting and welding "on the top side" as the most practical means of solving numerous construction problems. But when conditions have called for cutting metals under water their engineering talent and "know how" generally have been devoted to circumvention. Many large firms have stated that they were afraid of underwater cutting and thought of it only in terms of headaches or unforeseeable costs.

In some instances there has been justification for this attitude, although many contractors have experienced the pleasant surprise of having underwater cutting of metals done on a flat rate basis at extremely reasonable cost. Actually, prices paid have dropped from $15 per lin. ft. in 1927 to less than $3 per lin. ft. by 1940. But only large or favorably located jobs have benefitted from this as it was necessary to procure the services of one of the few divers experienced in this class of work, frequently entailing distant travel and considerable expense for unproductive days.

Up to 1942, the oxy-hydrogen underwater cutting process was almost universally used and probably will continue to be so for major jobs. But the use of this equipment requires extensive training and only a few divers are qualified in this specialty. Underwater welding was completely out of the picture as it had not been available outside of the laboratory prior to 1942.

Rapid development has followed improvement of the arc-oxygen process of cutting and electric-arc underwater welding since it was developed to the practical stage in 1942 by the United States Naval Engineering Experiment Station at Annapolis. Commercial development of satisfactory electrodes and equipment have advanced arc-oxygen use to the point where the marine contractor can handle underwater cutting of steel, cast iron, bronze and other nonferrous metals with any local diver, without prior training, in the same routine way that work is done on the surface.

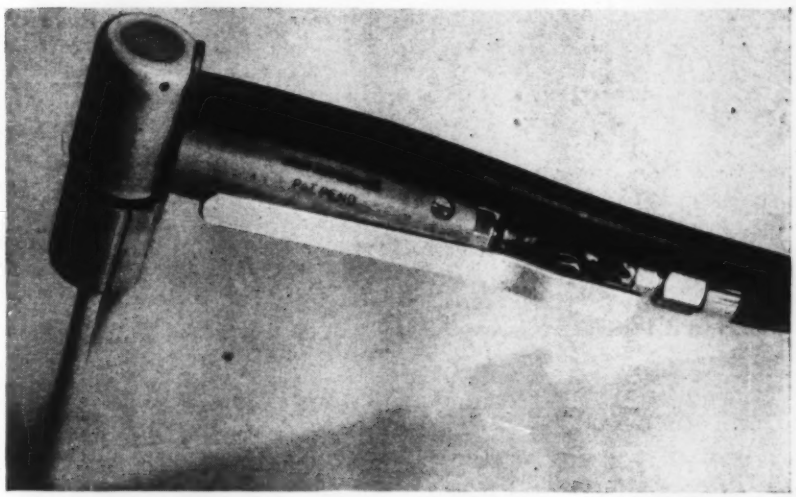

Fig. 2. Arc-oxygen fully insulated underwater cutting torch. Lead to electric welder is seen above and connection, through a control valve, to oxygen supply below. A quarter-turn of the collet releases rod stub or makes a firm electrical contact.

The arc-oxygen process

The basic principles of arc-ogygen cutting have been known for about 20 years and are very simple. The electric arc is used as a means of preheating the metal, combined with use of pure oxygen under pressure as the cutting agent.

In practice, one lead of a standard 300 amp. direct-current electric welding machine is connected to the work as a ground and the other lead to a suitable torch held by the diver. A tubular steel electrode is inserted in the torch and the oxygen delivered through the hollow center of the electrode.

The arc-oxygen underwater cutting torch is really a very simple tool but must be fully insulated and carefully designed to meet the special conditions under which it is to be operated. A modern torch is shown in Fig. 2. It consists of a copper alloy head to which a short length of leader cable is directly connected and into which the electrode is inserted through a holding device that establishes a firm electrical contact and at the same time seals the end into the oxygen supply. Oxygen is brought into the head through a lever control valve in an insulated handle.

Since electrodes are used up rapidly, it is necessary to provide for quick release of the stubs and easy replacement under water. In the model shown, a quarter-turn of the collet locks the new electrode in position and a quarter-turn release permits blowing the stubs out with the oxygen before the insertion of a new electrode.

Continuous cutting in any position with full penetration is easily accomplished by any average diver. It is only necessary to *strike the arc and drag the end of the electrode across the work*. Underwater cutting electrodes commonly used are tubular steel (14 in. long), flux-coated, waterproofed and thoroughly insulated over the entire usable length. These are lower in cost and require less skill for use than do hollow-carbon electrodes or tubular ceramic electrodes that also are used with the process.

Rapid cutting underwater

An average diver, working under ordinary underwater conditions, will cut $\frac{1}{2}$-in. to $\frac{3}{4}$-in. thick steel at an average rate of 25 to 30 ft. per hour. A highly skilled man will do better, while even a beginner will approach the average speed within a few days after he makes his first cuts.

Visibility is a minor factor in this new process. The diver places the end of the electrode on the work, calls for "current on," strikes the arc, and drags the electrode across the work, cutting continuously until the electrode is consumed. After the diver has signalled for "juice off," he releases the stub by "blowing it out," inserts a new electrode, and when he again calls for "current on," observers

WHAT IS NEEDED FOR UNDERWATER CUTTING

Insulated arc-oxygen cutting torch with short leader cable. Waterproofed, coated tubular electrodes.

Welding lens, four to six shades lighter than required on the surface, in hinged frame for mounting on outside of diver's helmet.

Rubber gloves or mittens attached to the diver's dress used with standard diving gear.

Conventional 300 amp. electric welder (d.c. preferred) with suitable long lead and ground connection.

Two-pole, single-throw, portable knife switch—placed in welding circuit at point convenient to the tender's helper.

Oxygen in cylinders with manifold for connecting two to five cylinders, oxygen regulator; and $\frac{1}{4}$-in. extra-heavy hose.

Note that all items will be found on the average job except the torch, electrodes, welding lens, gloves, switch and manifold.

on the surface can tell that cutting is being done. The time required for electrode change is no longer underwater than on the surface.

Because of the basic relations between the "arc time," the length of rod and volume of oxygen required for cutting metals of known thickness at a specific depth, the consummable supplies required can be estimated very closely. For example, 100 lb. of tubular steel underwater cutting electrodes and four cylinders of oxygen will be consumed by an average diver in cutting 300 to 350 lin. ft. of ½-in. to ¾-in. thick steel at a depth of about 40 ft. For ⅜-in. or ¼-in. thick steel, the consumable supplies are about 20 to 40 percent less than the above and for 1-in. thick steel are only 10 percent more.

The cost of consummable supplies per linear foot averages as follows:

¼ in. thick steel	15 to 18 c.
⅜ in. thick steel	20 to 24 c.
½ in. to ¾-in. steel	25 to 30 c.
1 in. thick steel	28 to 33 c.

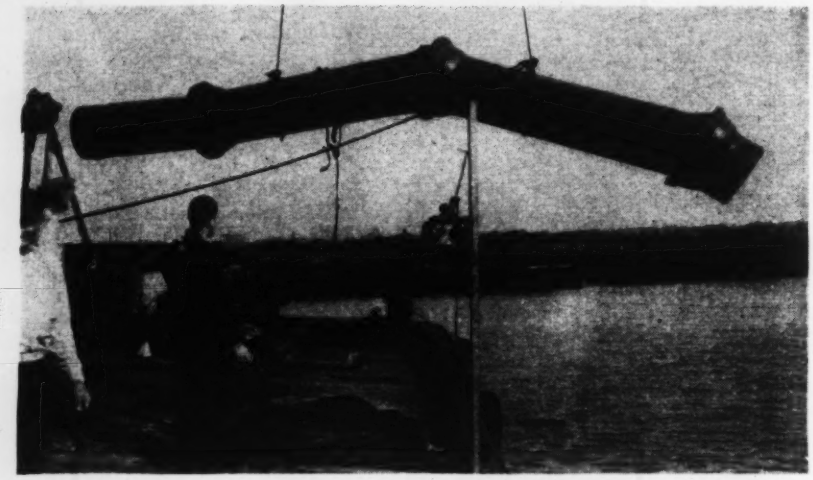

Fig. 3. Section of 30-in. dia. cast iron pipe brought to the surface after it was cut free from line 40 ft. under water. Note two-way divers telephone with loud speaker.

Fig. 4. Close-up of 30 in. dia. cast iron pipe 1½ in. thick cut at a depth of 40 ft. in the Hackensack River (New Jersey). Merritt-Chapman & Scott Corp. diver had only a few minutes instruction on surface before doing the cutting underwater.

Cast iron can be cut as readily as steel although at a somewhat reduced speed, the rate depending upon the skill of the operator, as the electrode requires a certain amount of manipulation. The speed will compare very favorably with oxyacetylene cutting of the same material on the surface and consummable supplies will be proportional to the arc time.

Cutting non-ferrous metals

The arc-oxygen process will successfully cut monel, bronze and other non-ferrous metals. Monel and bronze cutting, either under water or in air, is no more difficult than cast iron and very similar in speed as well as in the electrode and oxygen consumption.

A few hours practice on the surface using the arc-oxygen torch on the "hard-to-cut" metals will enable the diver to learn and apply without difficulty the special technique necessary under water.

The arc-oxygen cutting process, using coated tubular steel electrodes, has numerous economical applications on work above water. For example, after reasonable skill is developed, cutting cast iron can be accomplished at greater speed and to closer dimensions than can be obtained with the oxyacetylene torch, especially for heavier sections.

Metals such as stainless steel, which cannot be cut with oxyacetylene in the usual way, can be cut with this process with ease and to close dimensions. Stainless steel cut with arc-oxygen requires only slight grinding in preparation for welding. Extensive tests have shown that the original properties of the metals so cut are left unimpaired.

Underwater welding

Underwater welding requires far more skill than is the case with arc-oxygen underwater cutting. However, the diver who is experienced in electric welding on the "top side" will have no difficulty in learning to weld under water after some practice, but he must apply himself diligently and carefully to every inch of weld deposited.

At the present time it is possible to weld only mild steel under water. Good welds will develop 80 percent of the tensile strength and 50 percent of the ductility of welds made on the surface. The fillet weld is the easiest type to use

as it provides a natural groove that the diver can follow, a great convenience under the conditions of limited visibility that frequently prevail under water. In general the same technique is used as on the surface, the important difference being in working "blind."

The only special equipment needed, in addition to a 300 amp. direct-current welder and leads, is a fully insulated underwater electrode holder, a supply of coated and waterproofed electrodes of the proper sizes for the work in hand and welders lenses similar to those used for cutting. The electrode holder is much simpler and less expensive than the arc-oxygen cutting torch as no gases are used with the welding process.

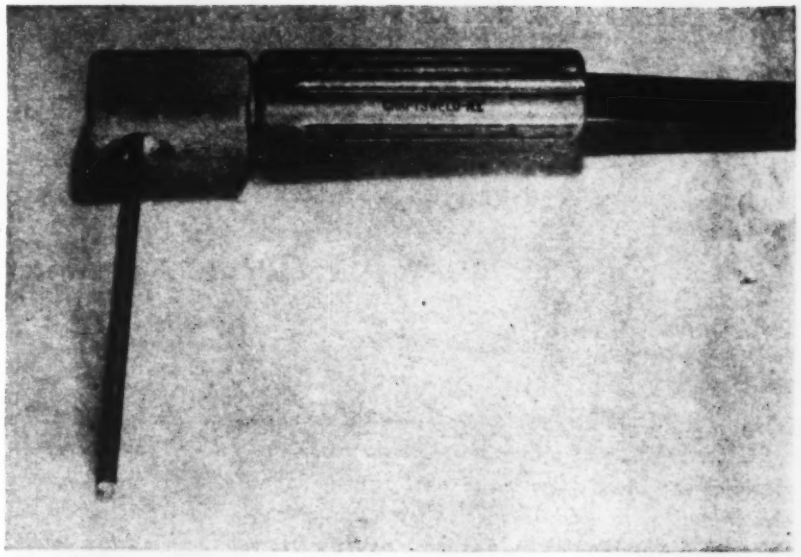

Fig. 5. Insulated electrode holder for underwater welding. Flux coating of rod serves to waterproof it.

Weld 15 to 20 ft. per hour

A capable diver, experienced in electric welding above water, who has acquired the proper technic for underwater work, will be able to make fillet welds at an average rate of 15 to 20 ft. per hour when working under favorable diving conditions. A skilled underwater operator will do considerably more.

More important, however, than speed is the quality of each inch of weld deposited so that it will be capable of carrying its proportional share of the load.

Due to limited visibility and the lower ductility obtainable in underwater welding, a high factor of safety is indicated. Typical values recommended are given in the table below.

As an example, a pad-eye intended for a lift of 10,000 lb. or a bracket for a similar load should be designed to allow for a minimum of 10 lin. in. of fillet welding.

The figures above are based upon the assumption that the metal will be deposited in a horizontal position by a diver adequately skilled in the process and that the work will be done under favorable diving conditions. The actual time for welding such a pad-eye, after the diver reaches the work and "gets set," will be only about one minute.

For a critical structure or connection, it is recommended that a sample weld, similar in design and position to that required, be made under water and brought to the surface for inspection and test under full load. If desired, a section of the sample weld can be cut out and stressed to destruction.

Other underwater equipment

In addition to the cutting and welding equipment described there are other new tools that have special values for use under water. Among these are the following:

a. Loudspeaker diving telephones, operating on dry cells, for selective communication between the surface and one, two or three divers, individually or collectively.

b. A pneumatic chain saw (for cutting piles), light enough to be operated by one diver.

c. Light weight diving gear consisting of improved face masks used with light dresses or without any dresses, suitable for work in shallow water at mild temperatures or for inspection and short jobs at deeper levels.

d. Stud welders that will operate under water to attach stud bolts for holding plates and the like.

e. Rifles that enable a diver to pierce steel under water or, to merely penetrate and leave a stud bolt firmly imbedded.

f. Explosives in new forms with a wide range of characteristics for use not only in blasting but also as a force of calculable magnitude for application underwater to accomplish a specific purpose. An example of its use is in removing or forcing on a propeller without putting the vessel in drydock.

g. Powerful lights that will illuminate work in murky water.

Men and tools available

Along with the development in underwater cutting and welding a large number of well trained divers and supervisors has become available all over the country. Some have been trained by contractors and others by the armed services; many of these have crowded a life time of diversified experience into a few years under a wide range of difficult diving conditions.

Thus, there now is a huge reservoir of competent young men and good tools for underwater work. Marine construction and salvage can profit greatly from their use.

RECOMMENDED VALUES FOR UNDERWATER WELDS

Size and type of weld	$\frac{3}{16}$ in. fillet
Position of weld	Horizontal
Size of electrode	$\frac{3}{16}$ in. dia.
Current used	210-250 amp.
Number of passes	One
Strength of weld	10,000 lb. per lin. in. of weld
Permissible static load (Factor of safety of 6)	1,600 lb. per lin. in. of weld
Permissible load when bending moment is involved (Factor of safety of 10)	1,000 lb. per lin. in. of weld

Operating Results Prove...

Sewage Filters Can Take A Doubled Load

F. M. Veatch and R. E. Lawrence
Black & Veatch, Consulting Engineers
Kansas City, Mo.

***Editor's Note**—Many articles are published describing the design and anticipated performance of a sewage treatment plant. But seldom is it possible to obtain an analytical discussion of what actually happened after the plant goes into operation. Hence the special interest that should be attached to this article by Messrs. Veatch and Lawrence on the performance of overloaded two-stage filters. Not the least of their findings is that filter loadings of as high as 750 lb. of B.O.D. per acre will produce an effluent whose stability is 90 percent or better. This and other facts related to the design and operation of the flow recirculation facilities provide new information on the load and "shock-absorbing" potentialities of the trickling filter process.*

THE sewage treatment plant at Fort Sill, Okla., has successfully handled flow volumes and organic loads far in excess of those contemplated in its design. This has been possible because of a number of features which were provided to absorb the shock of possible overloads. These are reflected in a study of the operating results, which has been completed by the designing engineers with the permission of the Army.

Completed in 1941 at a cost of $195,000 the plant is a two-stage trickling filter plant designed to treat 1.83 mgd. of sewage from a tributary population of 26,000. The effluent is delivered into a receiving stream whose flow is intermittent in character and the production of a highly stable effluent is essential.

Prior to construction of the new plant, sewage treatment facilities at Fort Sill consisted of a lift station, a battery of septic tanks of the Doten type, dosing chamber, trickling filters of the fixed-nozzle type and sludge drying beds. These served the post as originally constructed in 1917 and the subsequent peace-time population, but were entirely inadequate for the expanded requirements of World War II. However, original plant construction, with modifications, was incorporated into the new design. The various units of the new plant, shown diagrammatically in Fig. 1, include:

Pumping Station—Raw sewage is screened through a bar-rack with $\frac{3}{4}$ in.

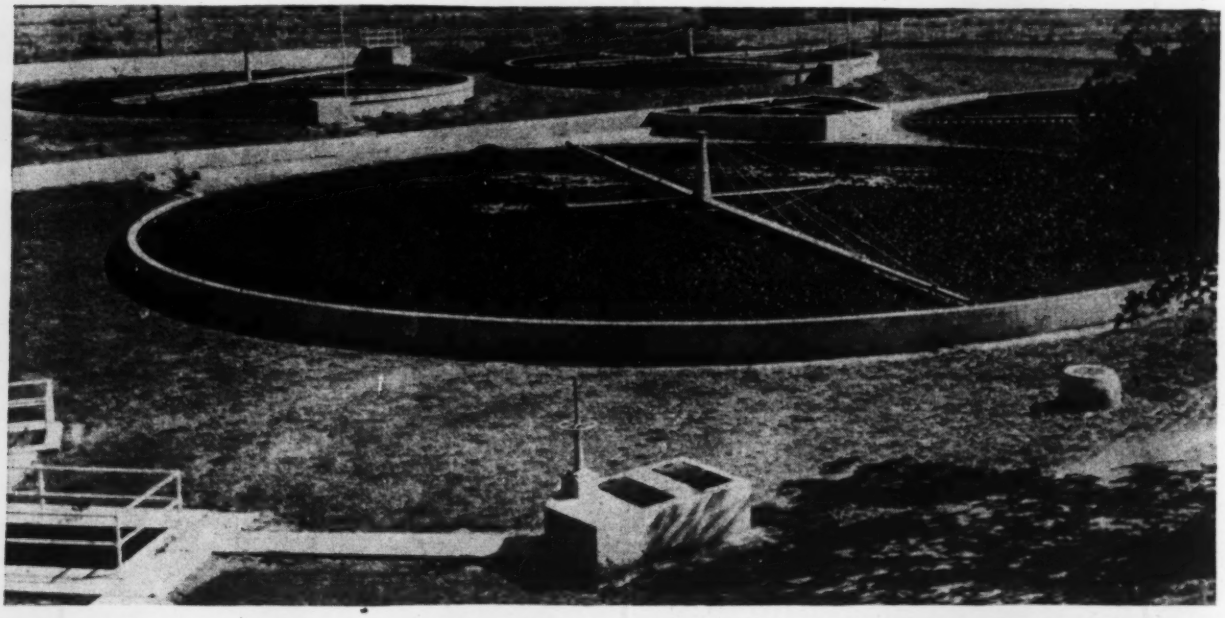

Fig. 1. Trickling filter installation at Fort Sill, Okla., is of the two-stage type. Primary filter units (background) are 85 ft. in dia. and 3.25 ft. deep. Secondary units, one of which appears in the foreground, are 130 ft. in dia. and 5 ft. deep.

clear openings and is discharged into a wet well together with the sludge from the intermediate and final settling tanks and the shredded screenings from the bar screen. Sewage is pumped from the wet well by two identical pumps, which have a combined capacity of 4.4 mgd., and is discharged into the inlet of the grit chamber. From this point the flow through the plant units is by gravity.

Grit Chamber—Two parallel flow channels, cleaned manually.

Pre-Aeration Tank—Grease removal is accomplished with a detention period of about 10 mins., using two mechanical aerators.

Primary Settling Tank—Rectangular in plan, it is equipped with sludge collectors and scum skimmers of the straight-line type. Detention under actual operating conditions is 1.65 hr., and the overflow rate is 991 gal. per sq. ft. per day. Primary sludge is pumped to the digester.

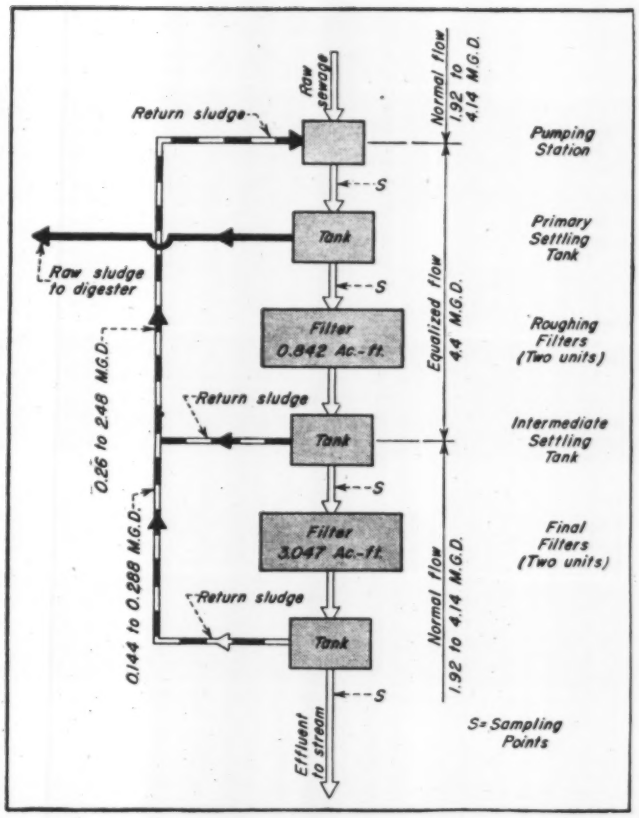

Fig. 2. Operation program showing the method and volume of flow recirculation through various units of the Fort Sill plant.

Roughing Filters—Two units, each of which is 85 ft. in dia. and 3.25 ft. deep. Total surface area is 0.2594 acre and the volume is 0.842 acre ft. or 1,358 cu. yd.

Intermediate Settling Tank—Diameter of 60 ft. with a side water depth of 8 ft., equipped with sludge collectors. Detention under actual operating conditions is 1.02 hr., and the overflow rate is 1,556 gal. per sq. ft. Sludge from this tank is delivered by gravity to the wet well at the pumping station through a line that has a hydraulically operated valve near its outlet. This valve is controlled by the water level in the wet well and therefore the effect of sludge withdrawal from the intermediate tank is to equalize the discharge rate of the raw sewage pumps since the water level in the wet well is kept practically constant.

Final Trickling Filters—Two units, each of which is 130 ft. in dia. and 5 ft. deep. Total area is 0.6094 acre and the volume is 3.047 acre ft. or 4,915 cu. yd.

Final Settling Tank—60 ft. dia., with a side water depth of 8 ft., equipped with sludge collectors. Under actual conditions the detention period has varied from 1.08 to 2.33 hr. with an average of 1.60 hr., and the overflow rate has varied from 678 to 1,462 gal. per sq. ft. per day with an average of 988. Sewage flow is measured by a wier located in a stilling box at the outlet end of the tank. Sludge is pumped into the wet well of the pumping station. The original sludge pump had a capacity of 100 gpm., but in April, 1943, this capacity was doubled.

Sludge Digester—One heated unit, 60 ft. dia. with a net sidewater depth of 27 ft. and a total volume of 78,000 cu. ft. Design capacity was 3 cu. ft. per capita but under actual operating conditions required capacity has ranged from 1.42 to 1.95 cu. ft., with an average of 1.66.

Sludge Drying Beds—Ten drained units with a total area of 32,260 sq. ft. Originally contemplated was 10 undrained beds with a total area of 75,000 sq. ft., but when this proved unsatisfactory due to poor drainage new beds were constructed and the remaining original beds have been used for lagooning supernatant liquor from the digester.

Operating conditions, inclusive of flow measurements and analytical results for the period from May 1, 1942, to Sept. 30, 1944, are summarized in Table I. Conditions contemplated in the design are shown in Col. 1 and those actually encountered are shown in columns 2, 3 and 4.

Analytical results used in the computations are monthly averages and, during practically all of the period, from 20 to 25 determinations per month of B.O.D. and suspended solids were made on samples that had been composited over a 24 hr. period. The summary is based therefore, on some 600 or more individual determinations, averaged monthly as well as for the periods.

It will be noted that the strength of the raw sewage is estimated to be equal to that of the influent of the primary settling tank. The assumption is made owing to the fact that regular samplings had not included raw sewage as such. Numerous individual tests made on samples composited simultaneously from raw sewage and from the primary tank influent have shown so little difference that the tests on raw sewage were deemed unnecessary. The figures for B.O.D. and suspended solids in raw sewage, (as given in Table I, lines 3a to 3f) are calculated, therefore, rather than observed values.

This procedure is not exact, but the probabilities are that the difference is so small that the general results as expressed in Table 1, would not be affected appreciably. A check of the returns from the intermediate and final tanks, as determined by differences between the influent and effluent, indicates that the procedure is approximate, but that errors in individual samples are compensating rather than cumulative.

The rather close agreement between contemplated and actual results is due, of course, to the fact that both the roughing filters and the final filters were able to handle loads in excess of

those contemplated and still produce comparable results when expressed as percentage of removal. This characteristic of a trickling filter has been recognized for many years but the really interesting feature, which is brought out very plainly in the individual results, is that a relative stability of 90 percent or more in the effluent can be expected when the filter loading expressed as pounds of B.O.D. is in the order of 750 lb. or less per acre ft. of rock whereas higher loadings result in a rapidly decreasing effluent stability.

TABLE I—OPERATING DATA AT THE FORT SILL, OKLA., TWO-STAGE TRICKLING FILTER PLANT—MAY 1942 TO SEPT. 1944

	Contemplated In Design (1)	Actual Conditions		
		Aver. (2)	Max. (3)	Min. (4)
TRIBUTARY POPULATION	26,000	47,000	55,000	40,000
SEWAGE FLOW				
Aver. daily, mgd	1.82	2.80	4.14	1.92
Per capita, gpd	70	59.5	.....	.....
Equalized flow thru 1st stage, mgd	3.64	4.4	.....	.....
CHARACTER OF RAW SEWAGE				
B. O. D., ppm	291	308	407	222
" lb. daily	4,420	7,182	9,528	4,692
" lb. daily per capita	0.17	0.159	0.173	0.128
Suspended solids, ppm	429	281	568	185
" " lb. daily	6,500	6,553	11,543	4,157
" lb. daily per capita	0.25	0.139	0.21	0.104
PRIMARY SETTLING TANK				
Detention at equalized flow, hr	2	1.65	.....	.....
Overflow rate at equalized flow gal./sq.ft./day	820	991	.....	.....
B. O. D. in tank influent, ppm	291	308	407	222
" " " " lb. daily	8,823	11,288	15,356	8,356
" " " effluent ppm	174.6	178	202	119
" " " " lb. daily	2,652	6,425	10,333	4,361
" removal, % of tank load	70	42.3	63.2	31 8
" " % of raw sewage load	40	66.3	101.4	51.8
Percent of raw B. O. D. in effluent	60	90.6	115	59.2
Sus. solids in tank influent, ppm	429	281	568	185
" " " " " lb. daily	13,007	10,299	20,817	8,429
" " " " effluent, ppm	171.5	97.6	146	64
" " " " " lb. daily	3,900	3,577	5,494	2,345
" " removal, % of tank load	60	65.3	73.7	59.7
" " " " " raw sewage load	40	102.3	132.2	78.3
Percent of raw sus. solids in effluent	60	54.4	71.5	45.7
ROUGHING FILTERS AND INTERMEDIATE TANK				
Volumetric filter dosage, mgad	14	17	.....	.....
Filter loading, B. O. D., lb. per ac.-ft. daily	3,157	7,748	12,274	5,197
" " sus. solids, lb. per ac.-ft. daily	4,630	4,248	6,529	2,785
Detention, inter. tank @ equalized flow	1.23	1.02	.....	.....
Settling rate " " " " " gal./sq.ft./day	1,287	1,556	.....	.....
B. O. D. inter. tank effluent, ppm	87.4	81.3	170	29.9
" " " " lb. daily	1,325	1,903	3,502	851
" removal, % of loading	50	69.7	84.4	58.3
" " lb. per ac.-ft. daily	1,575	5,227	7,202	324.4
Sus. solids in inter. tank effluent, ppm	107.2	53.6	82.0	31.9
" " " " " " lb. daily	1,625	1,255	1,865	845.
" " removal, % of loading	72.5	64.0	77.3	52.2
" " " lb. per ac.-ft. daily	2,828	2,645	5,026	1,704
OVERALL REMOVALS IN 1ST STAGE				
B. O. D. removal, % of raw sewage load	70	73.2	87.8	57.5
Sus. solids " " " " " "	75	78.9	89.2	75.9
FINAL FILTERS & TANK				
Volumetric filter dosage, mgad	2.98	4.6	6.8	3.15
Filter loading, B. O. D. lb. per ac.-ft.	435	625	1,139	262
" " sus. solids lb. per ac.-ft.	533	412	550	278
Detention, final tank (normal flow), hr	2.46	1.6	1.08	2.33
Settling rate, final tank, gal./sq.ft./day	643	988	1,462	678
B. O. D. in final tank effluent, ppm	26.2	26.6	50.6	15.0
" " " " " lb. daily	398	620	1,121	364
" removal, % of loading	70	69.0	78.8	25.3
" " lb. per ac.-ft. per day	325	431	895	72
Sus. solids in final tank effluent, ppm	38.6	21.6	39.2	12
" " " " " " lb. per day	585	504	869	288
" " removal, % of loading	64	61.8	70.8	51.0
" " " lb. per ac.-ft. per day	341	254	328	145
OVERALL REMOVALS ENTIRE PLANT				
B. O. D. removal, % of raw average load	91	91.5	95.0	88.2
Sus. solids " " " " " "	91	92.4	94.3	89.8

Method of operation

The operation program, as shown in Fig. 2 is as follows:

Raw sewage enters the wet well of the pumping station at its normal rate of flow, which has varied from 1.92 to 4.14 mgd., with an average of 2.8 mgd. Sludge from the final settling tank, is pumped into the wet well at rates of 0.144 or 0.288 mgd. The water level in the wet well is maintained constant by the automatically controlled addition of sludge from the intermediate tank and therefore the sewage pumps operate continuously and at a constant rate. In this case the pump impellers were adjusted to deliver 4.4 mgd., slightly over the actual maximum rate of sewage flow.

Due to equalization the flow through the grit chambers, the grease removal tank, the primary settling tank and the roughing filters is constant at 4.4 mgd., which is also the rate of flow into the intermediate settling tank. Due to the controlled withdrawal of sludge however, the effluent leaves this tank at rates of flow approximately equal to those of the raw sewage and these rates are maintained through the final filters and the final settling tank. It is believed that equalization of flow through the primary settling tank and roughing filters is largely responsible for the efficient operation of these units.

A typical chart from the flow meter at the plant is presented in Fig. 3 to illustrate the effect of this flow equalization. Line A on the chart indicates the actual rate of flow since it is a record of the flow over the effluent weir and it includes everything that enters the plant except the sludge pumped from the primary tank to the digester. Since supernatant liquor is lagooned, the volume of this sludge (which has varied from 12,000 to 29,000 gpd.) is taken entirely out of the system.

Flow equalization principles

Line B represents the equalized flow of 4.4 mgd. The actual difference between the "normal" and the equalized flow in this case has varied from 0.91 to 1.95 mgd. with an average of 1.63 mgd. or 37 percent of the total

equalized flow (58.3 percent of the normal flow).

There are several important differences between flow equalization as practised at this plant and recirculation as commonly applied at "high-rate" trickling filter installations. Probably the most important difference is in uniformity of rates of operation in the plant units.

"Recirculation" is commonly applied by means of pumping, which means that the rate of recirculation is dependent on pump capacity and is constant for any particular pump or combination of pumps; it follows, therefore that the actual sewage flow is increased by an amount equal to the recirculation but still retains its normal variation. If, for instance, it were desired to recirculate 1.63 mgd. continuously it would mean first, that the raw sewage pumps would have to operate under the varying head conditions caused by a flow variation of from 1.92 to 4.14 mgd., and second, that the primary units of the plant from the grit chamber to the intermediate tank would have to operate at rates from 3.55 to 5.77 mgd.

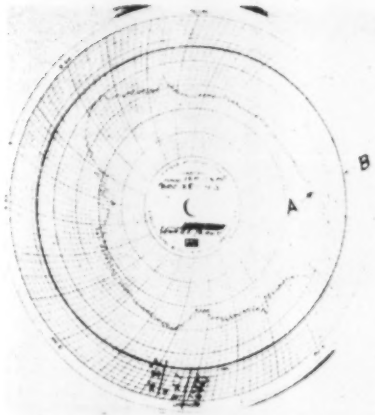

Fig. 3. Typical flow meter chart. Line A represents actual rate of flow and line B indicates the equalized flow.

Aside from the expense of installing and operating separate pumping facilities, which are not always necessary, the operation of the sewage pumps under varying head conditions is appreciably more expensive than under constant conditions to which pump efficiencies may be adjusted. Of considerably more importance than the matter of pumping cost, however, is the reduction in tank and filter efficiencies due to the variation in detention periods, overflow rates and rates of application.

Another important difference is in the matter of quantity. Recirculation rates are commonly in the order of from 100 to 150 percent of the normal flow or from two to three times the amount of sludge actually returned in this case. This requires additional capacity in pumps and in settling tanks, and it is believed that a comparison of the results shown in Table I with those from plants where recirculation at high rates is practiced will indicate that there is no particular advantage in increasing rates of the normal maximum flow.

These differences are mentioned for the reason that it is believed that none of the current process patents are infringed at the Fort Sill plant.

This plant has had the advantage of unusually intelligent operation. It is believed that it represents an economical and flexible application of trickling filters and has demonstrated the ability of this form of treatment to handle substantial overloads without serious reduction in efficiency.

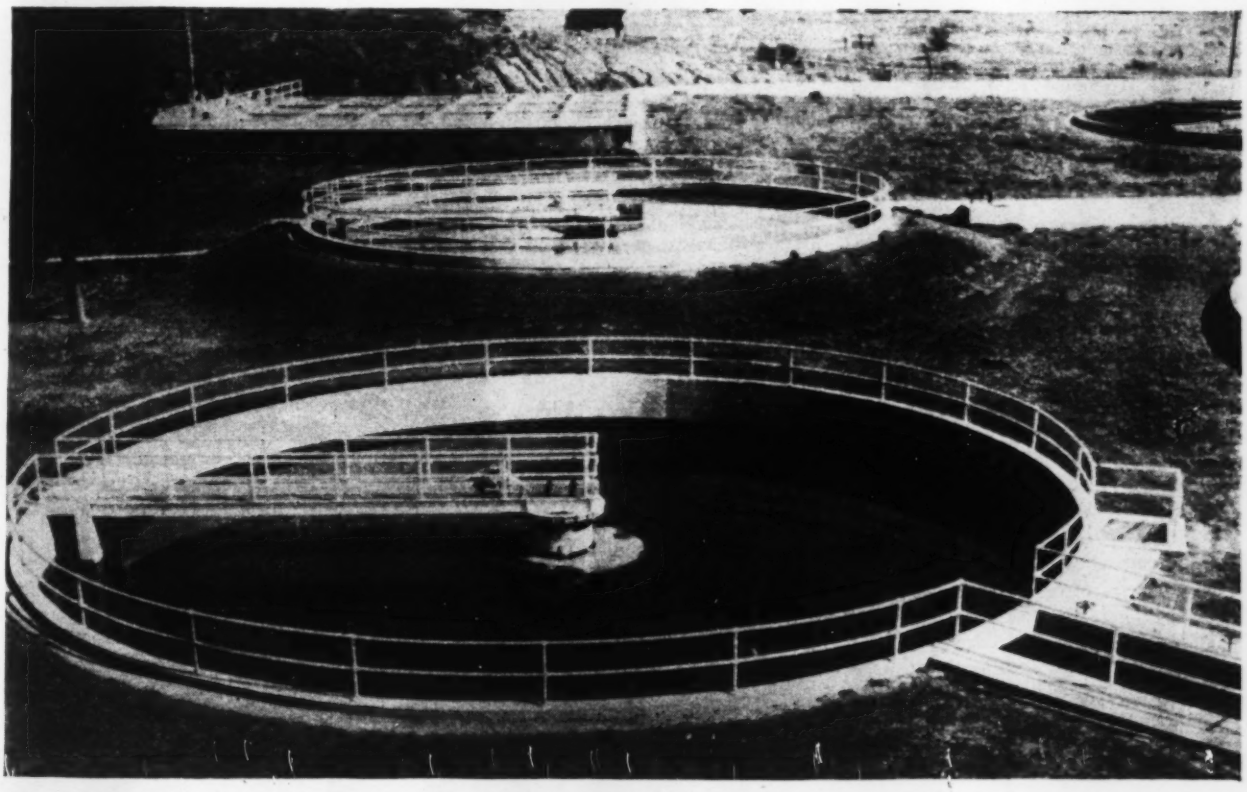

Fig. 4. Partial view of the settling tank layout. The final settling units are in the foreground, the primary tanks in the background and the intermediate tanks are in between.

Fig. 1. Pavement bared by direct application of sodium chloride to a 2 ft. wide strip down its center.

Ice Prevention on New Hampshire Highways

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***Contents in Brief**—Sodium chloride applied directly to the center of highways in New Hampshire has prevented formation of ice from snow and freezing rain. Costs as well as labor and equipment used have been substantially lower than for application of chloride-treated abrasives to do a less satisfactory job.*

MARKED PROGRESS toward providing safe highways to drive on during winter months has been attained in New Hampshire through the use of direct applications of sodium chloride to obtain bare pavements.

Prior to 1941, it was usual practice to spread chloride-treated sand on the compacted snow or ice covered pavements. This treated sand was spread along the center of the highway for a width of about 6 ft. Because the highway was sanded continuously, rather than just curves, hills, and intersections, the quantity of material used each winter was enormous.

These sanded surfaces of snow and ice were of some assistance to the traveling public but they did not furnish the safety provided by bare pavements.

Experiments successful

In February, 1941, experiments were begun with sodium chloride as an ice preventative. It was considered desirable to clear at least the center of the pavement for a width of 6 ft., this being the width sand was generally spread on a two-lane road in the earlier operations. The procedure followed was to spread CC grade sodium chloride at the rate of ¼ lb. per sq. yd. for a width of about 2 ft. along the center of the pavement, immediately after the snow plowing had been completed.

It had been noted that immediately following a snowstorm the temperature usually remained above 20 deg. F. for a short time. It was hoped that this period would be sufficiently long to permit the chloride to be dissolved by the moisture from the snow and in doing so to clear the pavement of snow that the plows were unable to remove.

In New Hampshire freezing rains fall when the temperature is above 20 deg. F. Slowly falling winter rain could provide the necessary moisture to gradually dissolve chloride and prevent the formation of ice on the pavement. This would permit emergency motor travel, at reasonable speeds, to use the highways during such a storm with some degree of safety, something practically impossible to attain by the use of sanding methods.

The few snow and freezing rain storms that occurred during the 1940-

41 winter were sufficiently cleared from the pavements by the application of sodium chloride to prove practicability of the method.

Early application essential

When the first snow and freezing rain storms came at the beginning of the 1941-1942 winter season some excellent and some poor results were attained from direct application of sodium chloride. Upon checking the reason for this variation it was found that many highway patrolmen had delayed spreading the chloride until several hours after the snow plowing had been completed; in these instances the pavements were only partly bared. In locations where the chloride was spread immediately after plowing was completed the entire pavement was cleared within a few hours.

Unfrozen, traffic-compacted snow can readily be cleared from a pavement by this use of sodium chloride if there is some vehicular traffic to break up and move the snow off the pavement. Once compacted, snow becomes frozen it is extremely difficult and expensive to remove.

The same conditions apply to freezing rains. Sodium chloride spread on the pavement as soon as ice forms and while it is still raining will clear the pavement; but the same chloride treatment will accomplish little, if anything, after the storm is over and temperature has dropped below 10 deg. F.

In some instances, it is desirable to spread chloride treated sand on hills to provide immediate traction while the direct application of chloride is clearing the pavement.

Another method of treatment also has proven satisfactory. In some sections of New Hampshire. The chloride is spread as soon as one inch of snow has fallen if the snow compacts under traffic. After the final plowing is completed those sections of the pavement not cleared are again treated. This practice generally prevents the snow from compacting during the storm and permits the plows to entirely remove the snow, if the accumulation is not too great or if the storm does not continue for too long a period of time.

Lower cost per mile

The average cost per cubic yard for sand spread on the pavement has been about $3.20. The cost of spreading sand at the low rate of 2 cu. yd. per mile for a two-lane road is $6.40, and when ice prevention is not practiced, one storm frequently requires many repeated sandings.

The cost per mile for one application of chloride at 300 lb. per mile, which is usually enough to clear the full width of the pavement, is about $3.50. In addition to this saving, there is the immeasurable value of having pavements that are free of ice or compacted snow on which to travel.

An accompanying table shows the expenditure for snow handling for the 1940-1941 winter; (the last winter in which abrasives were used exclusively)

COMPARISON OF COSTS OF WINTER MAINTENANCE BY SPREADING ABRASIVES AND BY ICE PREVENTION

USING ABRASIVES, WINTER OF 1940-1941

	Cost, 2833 miles	Cost per mile
Chlorides for sand	$41,288	$14.57
Sanding	520,966	183.88
Plowing	243,552	85.96
Snow fence	33,323	11.76
Night weather patrol	45,013	15.89
Total cost	884,142	312.06

The total average snowfall for the State during this period was 73.9 in., which was 12.4 inches below the average of the past ten winters.

ICE PREVENTION, WINTER OF 1944-1945

	Cost, 2991 miles	Cost per mile
Chlorides for sand	$8,879	$2.97
Chlorides for ice prevention	115,452	38.59
Spreading chlorides	60,811	20.33
Sanding	137,755	46.05
Plowing	404,221	135.12
Snow fence	39,836	13.32
Night weather patrol	8,970	3.00
Total cost	775,924	259.38

The total average snowfall for the State during this period was 90.6 in., which was 5.7 in. above the average of the past ten winters.

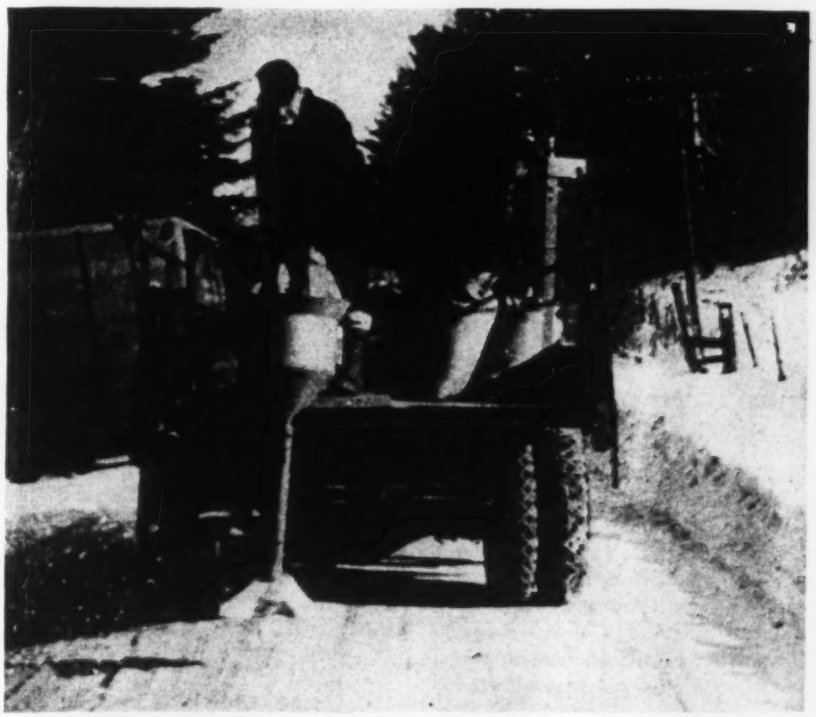


Fig. 2. Spreading sodium chloride on New Hampshire's highway is done with simple equipment developed by a highway patrolman. The chloride bag rests on a table while its contents are fed into the hopper.

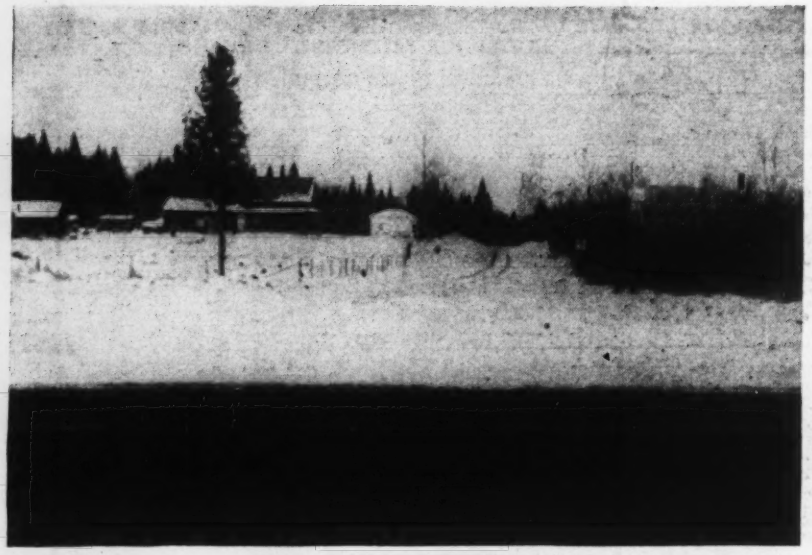


Fig. 3. Sodium chloride treated road in foreground is bare while the road in the background has a coating of compacted snow, though it has had chloride-treated sand spread over the center of the roadway.

compared to the 1944-1945 winter, when ice prevention was practiced.

Costs for the 1944-1945 winter were 75 percent more for labor and 25 percent more for equipment than those paid during the 1940-1941 winter. Miles plowed increased from 2,833 to 2,991 and the total snowfall was 74 in. compared to 91 in. in the latter period. With these factors considered, the financial saving to the state is much greater than the tabulations show.

Less man-hours and less equipment-hours per mile per winter were required for direct application of sodium chloride than for spreading abrasives. This was particularly important during the war years when military requirements depleted the number of men available for this work and when new equipment was practically impossible to obtain.

Desirable regardless of cost

Ice prevention with the method described has proven best in New Hampshire for maintaining highways during the winter months. Ice prevention is a radical departure from the older practice of trying to skid-proof ice or packed snow with abrasives. And experience in the past few years has shown that bare pavement maintenance costs less than the older method.

If cost of winter maintenance was increased rather than decreased by this practice of ice prevention, with resulting bare pavements to drive on during the winter months, it still would be most desirable.

Steel Pile Undergoes Curious Deformation

A steel H-pile recently removed from foundations of the Lytle Creek Bridge in San Bernardino was found to have a lower end that had undergone curious deformation when the pile was driven. The old bridge foundation had to be taken out to make way for the improvement of Lytle Creek channel and in the course of this work a number of steel piles driven in 1931 were removed.

Excavation for the improvement project extended about 35 ft. below the deck of the old bridge and at this point was almost entirely through sand and small gravel with a few boulders of large size. Apparently all of the steel piles penetrated at least to this depth without undue damage in driving.

It is believed that a layer of large boulders many feet deep underlies this portion of the channel and that the top of the layer is generally above the level to which the steel piles were to have penetrated. The pile under discussion, it is suggested, may have landed on the flat face of a large boulder with other boulders nested around the pile sufficiently to prevent side deflection, thus accounting for the accordion effect in the lower part of the pile. The sand and fine gravel above could have given enough support to prevent buckling or bending.

Unusual deformation on the lower end of a 10-in. H-beam driven as a pile. The deformed tip, cut from the straight portion, is shown here upside down.

The following data are taken from a report made in 1931 on the driving of these piles.

The piles were 10-in., 49½-lb. H-beams driven with a 9B2 steam hammer and jet to an average penetration of 35.2 ft. Driving was done with a dragline converted into a piledriver by hanging a 42-ft. fixed timber lead from the boom and a 23-ft. steel telescope lead. The timber lead was braced to the machine at the bottom with timber beams. The driving was difficult and was aided by a jet; the material encountered was alternate layers of sand and gravel with occasional boulders.

The jet was found to penetrate the gravel better with a large quantity of water at low pressure than with a smaller quantity at high pressure. The most effective jet was found to be a 2-in. dia. pipe with a 2-in. opening (no nozzle) under 125-lb. pressure. Water was supplied from a reservoir 200 yd. distant by a 6-in., single-stage centrifugal pump; a 6-in., two-stage centrifugal booster pump was used on the 6-in. pipe near the jet.

The Highway Contract Situation

C. M. Hathaway
Engineer of Construction, Illinois Division of Highways
Springfield, Ill.

***Editor's Note**—Just what is the responsibility of the contracting fraternity to the impending roadbuilding program? How should contractor organizations be geared to the job ahead and what size contracts will be the most economical and feasible? What new types of equipment will we need and what will be the costs of construction? Solutions of these and other timely questions were approached in such a realistic manner in a paper presented by Mr. Hathaway at the meeting of the Associated General Contractors of Missouri on Jan. 19, as to warrant its publication in the following abstracted form.*

ONE of the most important thoughts that should be kept foremost in the minds of contractors, highway engineers and government officials today is that of dispelling any idea which the people have that this postwar program is merely a federal allocation of funds to the states for creating employment.

As a matter of fact, I am certain that the money allotted by PRA for the next three years will be far short of what we shall need within that period to bring our roads to where they were before the war. It nevertheless is true that the federal allotments introduce some new and important features, such as the resumption of work on the secondary system and allocations for work in urban areas.

Another vital question today is just where does the contracting fraternity stand in its ability and plans to carry on a postwar program? I know that you contractors have been studying it from its various angles for months, but I am not so sure that you are not in about the same huddle that we are, and that you may be confronted with the fact that the day is here and still your house is not wholly in order.

Size of contracts

This leads to the question which puzzles the engineer today. What is the proper size of contract to put out in this postwar program? Should we continue as we have in the past to let what we consider moderate sized contracts, involving five or six miles of paving, including grading and bridges, or should we attempt larger contracts or combinations to give a greater opportunity to the large general contractors? Before you answer that, remember it is a matter of economics to the highway engineer under certain physical limitations.

During the war, contractors were permitted to split up a large contract, to pool the work, and to combine the equipment of several outfits. Is this going to be a good policy for the future? From experience, we in Illinois have always felt that a dirt mover and an independent bridge contractor could do work cheaper in their own specialized line. There are difficulties to such a proposition unless the grading and the bridge work can be practically completed before awarding a contract for the pavement. Perhaps the same results might be secured better by awarding the whole job to the general contractor, with the idea that he may sublet his heavy grading and his culvert work. In fact, that is just what some of the larger general contractors have been doing.

This brings up another situation that we must consider, at least in our state. It is quite evident from the way that the funds are allocated by the federal government—for primary system, secondary system and urban construction—that the work must be scattered thoughout the state, even on the primary system. In addition, we must consider the amount of work that will be done by the counties and the cities, which undoubtedly will be greater than it was before the war. The evidence indicates plainly that a majority of the individual jobs will be moderate to small in size.

Is this going to revive the smaller organizations and produce an influx of individuals who have had moderate funds and aspirations for years to go into the contracting game? In my own mind there is no doubt of this, especially in connection with county and city work and the secondary highway program. But after a thorough analysis, I see no reason for discouraging such a move, because it is a good training ground for the industry.

It may be that the time is here when the contractors will consider a subdivision into two or more classes, each class capable of handling work of a certain character and magnitude.

Problems of equipment

The question of equipment must be considered from two angles—the contractor who has developed a large organization to handle war construction, and the contractor who has either sold or let his present equipment run down due to inactivity caused by the war. The former undoubtedly has too much equipment on hand—perhaps even more than he will ever need on a highway construction program—and it may be of a different nature, or even designed to do work at a tempo exceeding ordinary construction practice. Moreover, a good deal of this equipment may be worn out and even now must be replaced.

I think we must admit that a great deal of the construction work done during the war period was under the stress of time and speed and that many new construction methods were developed. We shall select the best of them, but I am inclined to believe that some of them have to be abandoned.

Then there is that other contractor who is low on equipment today and uncertain as to what he should buy, how complete an outfit he should assemble,

and what type and size of equipment to fit into the picture.

This is a real problem, and I have been trying to find the answer myself. My conclusion is to urge caution until the real scope of postwar highway construction is developed. What I mean by that is: What will be the stable program after the first two or three years' rush is over? I caution you that it is better to stabilize on the prospects of the next ten years rather than the next year or two.

Contract costs

The one question today which overshadows all others in highway work is construction costs, and when I mention this I do not mean a comparison of the contractor's bid with the engineer's estimate. Are we in a stable market today; if not, when may we expect it? Until then, the situation which confronts us is one wherein construction costs may have reached a figure where economics do not justify our buying the product.

This is a blunt statement, but it may be true; nevertheless, it is a problem for both of us to study. At least three state governments have evidenced their opinion that until the cost of the finished product is reduced, they cannot afford to buy.

Whatever your sentiments are, bear in mind that any governmental unit has a definite obligation to the public in the expenditure of public monies and it may be called upon to justify great increases in cost. Also realize that the policy on highway construction may be a guide for other local governmental and private enterprises.

Next there arises this baffling problem: What will be the result if we do stop construction operations with our highways in their present condition when we have before us the certainty of increased traffic, which has already demonstrated itself, and the matter of safety, which again has assumed proportions that are truly alarming?

In view of the seriousness of the situation, this may be an opportune time to interchange ideas on costs today with an idea of a possible solution. Construction cost, in general, may be divided into four elements: equipment, overhead and profit, materials and labor. Equipment includes the purchase of new equipment, depreciation, repairs, moving charge, plant setup, and operation, exclusive of labor. Although the cost of new equipment and repairs will be materially affected by the labor situation, yet it appears that this is one item where there might be more stability than the others and where the contractor might be expected to be reasonably conservative.

Overhead and profit

Overhead may be stable, but profit distinctly is not. However, except for the percentage allowed for uncertainties, profit should be stable, so let us put this protection item where it properly belongs—under labor costs.

The cost of materials is by far the highest in money value, although it has been reasonably stable even during the war. Recently I have heard some rather definite statements that material prices must likewise be advanced. This seems only imperative under present conditions, but it should be computable. This is the time for the producers to make every effort to carry on, and it may be good business for them to subjugate themselves to rather low profits until the period of stabilization is achieved.

The fourth and most intangible item of all is the scarcity of labor coupled with wage scales, regulations and efficiency. Under present conditions, few contractors are in a position to accurately figure the cost of a job.

It is untimely for me to enter into any discussion of how the contractor or his organization should conduct themselves, but I shall venture to express certain basic principles that may be worth consideration by both sides. In the first place, when is the contractor going to be permitted to develop and operate an organization as he did 15 years ago? That is, maintain a reasonably permanent crew and move it from job to job.

Permanent organization needed

It is essential that a contractor's key men, skilled or otherwise, should be permanent. For example, a good local crane operator may be secured for any certain job but he probably will not move on to the contractor's next job. Such a man will be unfamiliar with the equipment, and will not be as efficient as one who has worked for you for the last ten years and who is interested in your profits. Until contractor organizations reach a degree of permanency, results obtained will be costly to both the contractor and the highway department.

It is not so much the labor scale nor the number of hours worked that determine the cost of construction. Those can be computed, but you must know that in any given period—week or month, or job—the number of hours paid for at a given wage scale will produce a given amount of work.

Guaranteed wage suggested

I am inclined to favor placing of labor on a guaranteed wage per week or per month at a regular scale, but we must receive from him the assurance of a given amount of work. Such a plan would seem to offer due protection to the laborer who must figure on his take-home pay.

I have enough confidence in labor today to believe that in spite of certain existing rules they can and will finally agree to some equitable scheme.

Labor is entitled to an equitable working plan, because after all, we must remember that highway construction is seasonable. This plan, however, must recognize somewhere that there must be a basic foundation to enable the contractor to make a rational bid, with the assurance that the work can and will be done without loss to himself.

New construction specifications

The question asked more than any other today is: Are there going to be many changes in the specifications and construction practices? This is natural, even vital, because the war has developed many new ideas in design and production.

New construction practices and new specifications will inevitably arise, but it will take time to work them into satisfactory shape. If they are drawn gradually into the specifications, you should have ample time to meet these changes as in the past.

Occasionally one hears rumors of drastic changes in construction practice which might even unbalance the economic structure of present practice, but the wise engineer is he who realizes that theory and practice must, to a large extent, coincide, and that changes of specifications and construction methods should not be made without a careful study of the economics thereof.

Offset Retaining Walls for Stockpiles

Homer M. Hadley
Regional Structural Engineer, Portland Cement Association, Seattle, Wash.

A SERIES of reinforced concrete walls to separate adjoining stockpiles of sand and gravel of various sizes has recently been constructed at the Steilacoom, Wash., plant of the Pioneer Sand & Gravel Co. Requirements set up in undertaking the design of the structure were that there should be supports for a belt conveyor above the stockpiles and beneath them provision for a belt conveyor in a tunnel; that the walls separating the piles should be of minimum cost consistent with strength to resist unbalanced loadings caused by a capacity pile on one side of a wall with no balancing load (above dead storage) on the other side. All this was to be accomplished without any struts or tie members extending from wall to wall through the stockpiles.

These requirements were met in what has proved to be a very satisfactory structure by working out a design in which 12-in. reinforced concrete division walls spaced 30 ft. on centers were stiffened by being offset or folded at right angles at intervals of 11 ft., in effect creating Z-beams at these offset points. The walls rise with the natural slope of the stockpiles to maximum height at the overhead belt.

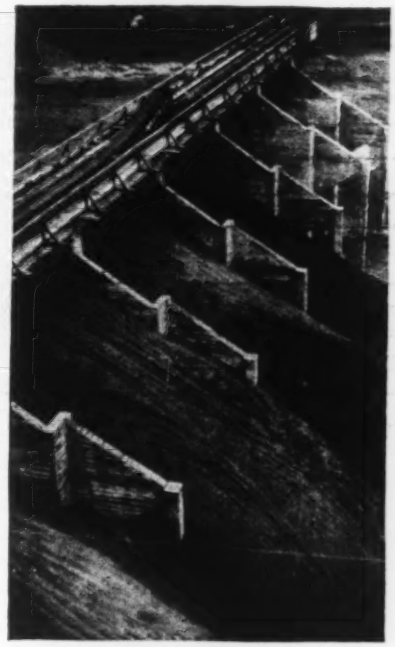


Fig. 1. Sand and gravel stockpiles 39 ft. high are separated by concrete walls.

The tunnel centered beneath the stockpiles was designed with the invert depressed some 5 ft. to reduce the amount of dead storage that necessarily accumulates below the level at which gravity will feed the material into openings in the tunnel roof.

To give an effective stockpile height of 35 ft. above tunnel roof openings, it was necessary to provide for a structure with a total height of 39 ft. 4 in. above the adjoining ground level. Nowhere do the walls exceed 12 in. in thickness and the only loss of storage space entailed by this design (in excess of what would be caused by a straight 12-in. wall) is in the relatively small volume comprising the four 1 x 3-ft. sections at the offsets and the two 6 x 18-in. sections of the end columns (see Fig. 2).

The ordinary bins or bunker-type of storage, first considered for this plant, were abandoned in favor of stockpiles with unrestrained outer slopes because of the ample space here available. The plant is located at the edge of an immense deposit of glacial material fronting on Puget Sound and extending inland for miles. All soft and friable material in this deposit was ground to a flour and washed away by the original glacial action, leaving only sand and gravel that has the highest quality in hardness and durability. Removal of material extending over many years has opened up an enormous, level area around the washing and screening plant. It is at the rear of this plant that the new stock-pile structure is located.

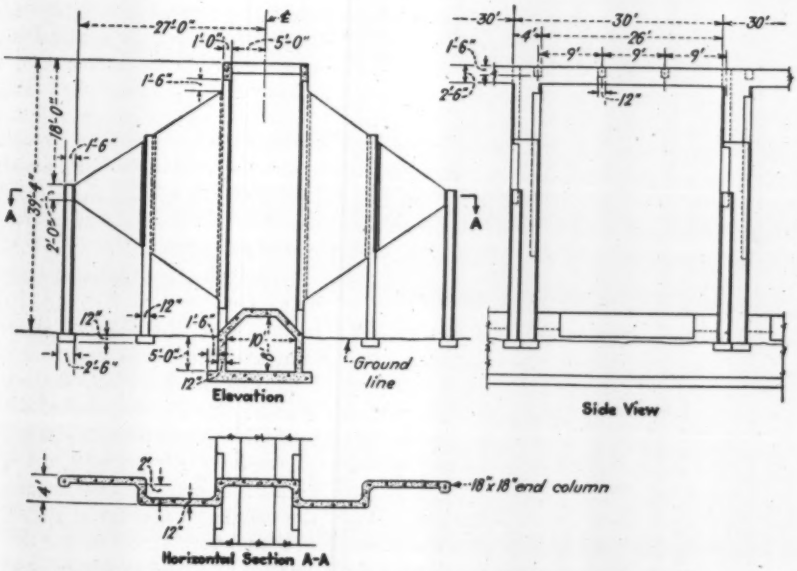


Fig. 2. Three views that give details of the reinforced concrete structure.

Efficiency in design

By meeting the requirements with a structure designed as outlined in the foregoing it has been possible to build along clean, simple lines with highly efficient use of the structural materials.

The continuous longitudinal beams carrying the upper conveyor serve as supports for the longest pair of folded or Z-section beams which come at the sides of the tunnel. This permits them to be designed as ordinary vertical beams while the outer ones were designed as cantilevers rising out of the dead storage material.

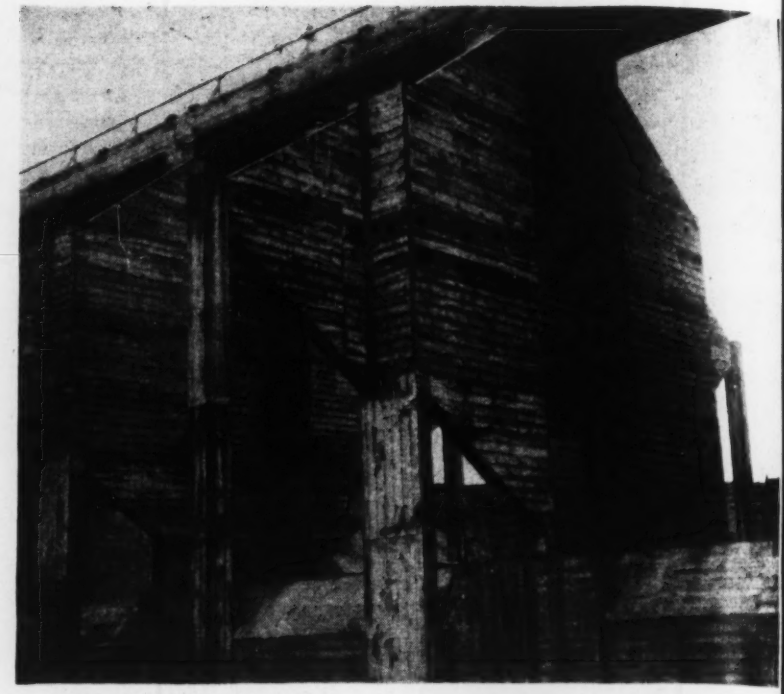


Fig. 3. Tunnel and walls before stockpiling began. Note Z-beam effect.

Dead storage material useful

All steel in the tunnel concrete is $\frac{5}{8}$-in. hard, deformed bars; reinforcing in the walls, both vertical and horizontal, is $\frac{1}{2}$-in. bars. Since there was no need for carrying the wall sections all the way down to the ground, they terminate along a line which gives their lower edges an embedment of about 2 ft. into the material that remains in dead storage. Only the sections of the walls at the offsets extend down to ground level as columns.

As here used the term "dead storage" refers to whatever remains on both sides of the tunnel after all the stockpiled material that will flow by gravity into the openings in the top of the tunnel has been withdrawn. This includes everything in the space between ground level, the natural slopes up from the toe of the full stockpile and the natural slopes of material from the edges of openings in the tunnel roof, extending upward on both sides of the tunnel to intersection with the outer slopes. This dead storage, though involving considerable volume, really fulfills a useful function in deflecting active material into tunnel openings.

The belt conveyor in the tunnel receives the material through overhead gates in the tunnel roof and delivers it either to scow at a nearby wharf or to railroad cars on a siding, as required.

The stockpile structure was built by the gravel company's forces under direction of George Christensen, plant superintendent. The design was developed by the writer.

Realities of Urban Redevelopment

Slum clearance and urban redevelopment movements are faced with two major difficulties which must be given serious consideration if the proper planning of such projects is to succeed, declared Miss Elizabeth Wood, executive secretary, Chicago Housing Authority, in a paper presented at the recent Public Works Congress in Chicago. These difficulties include the formidable cost of such improvements as well as the extensive length of time needed to complete them.

Quoting from recent experiences of the Chicago Housing Authority, Miss Wood enumerated certain realities that must be taken into account in the planning of projects. One of the first realities she said, is that of physical decay. Although this might appear to be one of the simplest of obstacles, local authorities have learned that building on slum land is a costly process.

Slum sites frequently are at a relatively low elevation and filled with many old foundations. Consequently, construction of new foundations is expensive. In filled areas, the material for grading often is a composite of old brick and stone, including all sorts of waste material. Even when dressed with good topsoil it provides a poor base for trees and shrubs, she said.

Inadequate service facilities

One of the most fallacious beliefs concerning slum-area rebuilding, declared Miss Wood, is that of utilizing existing service utilities. Old water lines frequently have inadequate capacity for the redeveloped area, sewer pipes are fragile, old and often at the wrong elevation. Disturbing the ground, followed by its subsequent settlement, frequently causes breaks in both.

Another of the realities encountered when replanning slum areas is that of relocating existing traffic and transit lines. Slum areas invariably are interlaced with streets, practically all of which carry large volumes of traffic. Many are ribboned by streetcars, crossed by elevated lines and traversed by heavy truck routes. The shear volume of this traffic—both freight and passenger—is one of the most difficult realities to face in replanning extensive slum areas.

Experience in Chicago has shown that no matter how aged the buildings or how great the physical decay, slum land is expensive to buy if it has any buildings on it at all, declared Miss Wood. The occupied buildings are profitable businesses to their owners, particularly during this era of acute housing shortage. One must pay for the buildings, therefore, not the value of the physical structure but the capitalization of the exorbitant income received from its rental.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Men for Construction

Sir: It is amusing to one who has had twenty years of experience as a general contractor erecting schools, banks, industrial buildings, apartments and dwellings (plus recent war experiences supervising construction of a U. S. Army Engineer Ordnance plant and a U. S. Navy building) to read of our national plan for housing, public buildings and commercial structures. This amusement is created by our national, state and local city governments, our statesmen and politicians, who are of the opinion that use of taxpayers' money, plus material cost control, will result in a tremendous building boom.

Somewhere in the bright colored picture, our leaders have forgotten that money and material alone do not erect buildings. Skilled labor is also necessary. No politician suggests that an inventory be taken of skilled mechanics in the Building Trade Unions who will be available when the actual labor need arises. Bricklayers, stone setters, concrete workers, plasterers, lathers, plumbers, steamfitters, electricians, carpenters, hoisting engineers and other building trades are skilled artisans.

Where are these skilled workmen to come from?

Where are there building trade training schools, acceptable to most building trade unions, which will grant a returning veteran or a willing unskilled worker the opportunity to become an apprentice in a skilled building trade union? Membership in unions have been, in most cases, limited in the past to relatives of mechanics, apprentices and those capable of paying high initiation fees.

No general would plan an offensive without being completely sure that each and every soldier under his command has had thorough training in the science of war. Why do our politicians plan a program to relieve housing shortages without being sure that skilled workmen are available to use the priorities for building material?

Those of us in the building and engineering field should do something to help the returning veteran. He is entitled to an opportunity to enter the construction field. He should have the support of every labor organization and employer in this country. Personally, the writer feels our veterans educational opportunities have too much emphasis on the academic development. The need to-day is for more skilled hands to supplement trained minds.

I hope the editors of the *Engineering News-Record* and their readers will suggest some practical way or means to remedy an inevitable shortage of skilled mechanics.

ARTHUR M. DOENECKE
Brooklyn, N. Y.

Design of Bridge Railings

Sir: In the issue of Jan. 10, p. 68, is a very interesting article on the design of bridge railings by Martin Deuterman. Attention is called, however, to two of the illustrations accompanying this article.

Fig. 5 shows a raised curb as a protection against traffic crossing the sidewalks and damaging or going through the railing. This raised curb appears to have a height varying from one foot to 15 in. This type of construction tends to force vehicles an unreasonable distance from the curb, in that drivers will crowd the left-hand portion of the traffic lane. It will also damage running boards and, perhaps, fenders and wheel caps if a car pulls too close either in motion or for the purpose of stopping.

Type of high curb used in Pittsburgh to protect bridge railings.

This type of curb also encourages drifting of snow and the gathering of litter. The accompanying photograph shows a raised curb used in this city, in which an air space is provided underneath the curb. Where this is used, sidewalks are generally swept clean and the traffic is not forced too far from the curb.

In Fig. 6 is a very artistic sidewalk railing, constructed low and with a broad top. Such a masonry railing could not be used in this city. Every child who crossed the bridge would walk on the coping and it is only a question of time until some one would fall off.

JOHN D. STEVENSON
Chief Engineer, Department of Public Works, Pittsburgh, Pa.

[Mr. Stevenson is correct in stating that the curb shown in Fig. 5 is higher than desirable. It is 12 in., and Mr. Deuterman states in the text of his article that the height of this type of curb should not be over 10 in.

As to the low railing shown as Fig. 6, there would appear to be risk of accident in using this type in an area where children cross the bridge frequently on foot; on the other hand, it could be used with safety on parkway bridges where there is almost no foot traffic.—EDITORS.]

Quick-Drainage Conduit

Sir: In *Engineering News-Record* Feb. 14, 1946 vol. p. 256 the use of a "U"-shaped conduit for airport drainage is noted. This is an interesting adaptation to a difficult drainage problem on an airfield of a device used in the drainage of drydock No. 1 at Pearl Harbor as described in the *Engineering News-Record* of December 9, 1909. The drainage of this drydock floor was through slots in cast iron "U"-shaped drains built into the floor so that no water on the surface of a floor would travel more than about two feet. The

conduits were of cast iron and the drainage system was designed so that a sufficient velocity of water would be maintained during pumping operations so as to prevent silt deposits. This system has been in successful operation since the Pearl Harbor drydock was completed.

R. E. BAKENHUS
Consulting Engineer,
New York, N. Y.

Education and Dirt-Moving

Sir: Something certainly should be done, and soon, to teach student engineers some of the fundamentals of construction. I have not seen a single curriculum leading to a degree of Bachelor of Science in Civil Engineering (or Mechanical Engineering) that contains even one course on "Earth-Moving," "Earth-Moving Machinery," or "Construction Machinery."

Every young graduate can tell you how to design a bridge or a dam, and will be able to make a presentable survey of a certain sector of terrain. But do they know the difference between a clamshell and a dragline—the most elemental of questions? Do they have any idea of how much fuel a power rig, whether gasoline or diesel, can be expected to use in a ten hour working day? Did anyone ever tell them the basic fundamentals involved in the use of explosives? Would they know how to operate a carrying scraper or even a tractor?

Lest my readers laugh too soon, most mechanical engineers are taught to fire boilers, operate overhead cranes, operate and make repairs to internal combustion engines, pumps, lathes, shapers, drill presses and other tools of industry as part of their laboratory or shop training. The intent is, of course, not to make the student engineer an operator, but to teach him the use, capabilities and limitations of the tools involved.

The same should be true of civil engineering curriculums. Before young men are graduated they should have become as familiar with the use and operation of all types of heavy construction equipment and explosives as they are with the transit or level. They should know, for instance, that the same crane can be rigged as any one of a number of pieces of earth-moving machinery, depending on the attachments used. They should know that a clamshell normally requires a holding line and a closing line, both reeved over the boom head back to each of two hoist drums and that a tagline and tagline counter-weight or torsional spring are necessary to keep the bucket from spinning and the line from fouling.

This is basic information, yet how few civil engineers know it? If there is any doubt on this score, let the reader enumerate the attachments necessary and the proper reeving of a dragline or of a shovel.

The construction industry needs well-educated engineers and it needs them as superintendents of construction and mechanical superintendents as well as in administration, design and control. There is a general upgrading of personnel throughout industry. Whereas cat-skinners may have been uneducated, tough and profane men ten years ago, today they are likely to be high school graduates. The mechanical superintendent and construction boss of yesterday might have gone through the eighth grade or had a couple of years of high school. We have reached the era of mechanization and the replacements for these construction men should have a sound technical education. Such an education must include courses that will familiarize the future construction men of the country with the tools that are in use today.

FRED F. KRAVATH
COMDR. (CEC), USNR
Public Works Officer
Naval Air Station
Coco Solo, Canal Zone

Data Book on Design

Sir: With respect to my book, "Data Book for Civil Engineers, Vol. I, Design", I would like to mention a couple of points which I think were missed by the reviewer (*ENR* Jan. 10, 1946, vol. p. 72), perhaps through deficiencies in my preface. When I said in the preface that I was trying to provide material so that an isolated engineer could function, I had in mind just that; namely that he *could* function, but I did not mean to imply that he should function without reference books.

In writing each section of this book, I asked myself what were the functional design criteria without which an engineer could not function. For instance, on bridges, an engineer cannot design the simplest culvert correctly without knowing the loading criteria, nor could he design correctly a bridge without knowing the wind loading criteria. Give him, however, the different loading criteria and clearances, and also adequate structural data, and he can design a bridge which will be safe, economical and in accordance with good practice.

In the same way, in the case of a dam, the loading criteria are such matters as hydraulic uplift, wave action, ice thrust, without which an engineer cannot design the simplest dam correctly. But give him these and other criteria and the design from then on is no longer a question of data, but a question of engineering principles and application.

A bridge or dam is a special case of the structural section just as a building is.

The structural data furnished in this volume, which are fundamental to the safety and permanence of all engineering structures, are intended to be the finest collection of structural data ever printed. I spared no expense or pains or effort to give the profession this particular thing, which my background peculiarly qualified me to furnish.

This book is a data book; it is not intended to displace reference books, and it was not my intention in the preface to claim that it does.

ELWYN E. SEELYE
Consulting Engineer
New York, N. Y.

Mr. Seelye's comments form a proper and instructive supplement to our review. In particular his pride in the structural data presented is justified, for they measure up completely to his principle to include "the fundamental design criteria without which an engineer cannot function." Both in selection and presentation the structural design material is excellent. It is by comparison that some of the other sections suffer, and thus create the unbalance that was referred to in the review, and that is perhaps inevitable in any book that covers the whole wide field of civil engineering.—Editor.

Correction

Under "cold-driving technique" in "More Effective Use of Rivets and Bolts", *ENR* Mar. 7, vol. p. 342, third column, the last sentence of paragraph 2 should read: "Hot-made rivets do not require annealing, although they should *not* be quenched".

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

Tables for Arch Design

ARCH DESIGN SIMPLIFIED—By W. A. Fairhurst. 61 pp. Concrete Publications, Ltd., London, S.W.1. 12 shillings.

Both open- and filled-spandrel, symmetrical fixed arches may be rapidly calculated, the author claims, by the use of his tables, which are planned to give the most economical design. These are based on the assumption that the most economical shape of arch is that whose center line coincides with the line of pressure for dead load plus half the distributed live load. Coefficients needed for design are given in 33 tables. Charts and drawings are conveniently provided to a large scale, derivation of formulas is given and typical problems are solved.

Cofferdams and Caissons

SHEET PILING, COFFERDAMS AND CAISSONS—By Donovan H. Lee. 192 pp. Concrete Publications, Ltd., London, S. W. 1. 10 shillings.

This British book presents in one volume the essential practical and theoretical data on sheetpiles and their use in cofferdams, piers and wharves together with information on open and pneumatic caissons of all sizes.

Some 40 pages of the book are devoted to formulas for and graphic determination of earth pressures on sheetpiles. Sketches and examples simplify the text so that it is readily usable by those only occasionally having to design for earth pressures. A chapter describes the several types of sheetpiles available—timber, reinforced concrete and steel—with the advantages of each. Driving and removal methods and equipment are discussed.

A long chapter rather completely covers the subject of cofferdams, from those for small piers to the cellular types for dewatering of large and deep areas. Information is given on underflow and saturation lines with means for determining stability of cellular cofferdams.

Current methods and theories on use of cylinders and caissons are included for use where cofferdams are not feasible, due to boulders or to necessity for penetration to great depths. Design data include pressures, skin friction to be expected in various soils and some details of cutting edges.

Labor and Labor Relations

ORGANIZED LABOR—Volume III of the Economics of Labor. By Harry A. Mills and Royal E. Montgomery. 930 pp. McGraw-Hill Book Co., New York 18. $6.

AMERICAN LABOR UNIONS—By Florence Peterson. 338 pp. Harper & Brothers, New York. $3.

LABOR POLICY OF THE FEDERAL GOVERNMENT—By Harold W. Metz. The Bookings Institution, Washington, D. C. $2.50.

PROFITABLE LABOR RELATIONS—By Paul Mooney. 209 pp. Harper & Brothers, New York. $2.50.

Four books on organized labor and labor relations have been published in recent months each one of which contains material of value to those directly concerned with labor questions.

Most comprehensive of the group is "Organized Labor," which is the third volume of a series entitled "The Economics of Labor." It gives a detailed history of the whole trade-union movement, summarizes available information as to trade-union policies and practices, reviews at length the court cases involving unions, discusses the problem of strikes and lockouts, and ends with a chapter on employee-representation plans and independent unions.

Some chapters of Miss Peterson's smaller book cover much the same ground as is covered in more detail in "Organized Labor," but most of the book is additional material, such as the information on membership rules, dues, and the constitutions of the AFL and CIO. Of special value to those wishing to identify unions is the tabulation of unions by name. Included is the affiliation and membership of each organization.

In scope, Mr. Metz book is considerably broader than its title "Labor Policy of the Federal Government" would indicate as it not only outlines what these policies are but also discusses the rulings of boards set up to administer the federal labor laws and the decisions of courts with respect to those laws.

The full title of Paul Mooney's book —Profitable Labor Relations and How to Develop Them—clearly indicates its content. Although the book is concerned chiefly with labor relations in industrial plants, many of the principles set forth could be applied to construction operations.

An Important Spanish Text

CALCULO DE ESTRUCTURAS RETICULARES—Tercera Edicion Reformada. By Carlos F. Casado and Jose L. F. Casado. Published by Dossat, S. A., Plaza de Santa Ana, 9, Madrid, Spain.

Here is a Spanish textbook that deserves to be translated into English as it incorporates the entire study of framed structures in a form that would be useful to students as well as structural engineers.

The book is divided into two parts, the first dealing with fundamental principles from the simplest up to and including the Hardy Cross method of design. Succeeding sections are devoted to examples, to other methods and to practical applications. The second part is devoted to building construction, bridges, symmetrical and unsymmetrical structures, towers, gallery or grandstand structures, and simple and double-span rigid arch structures.

An appendix contains load and moment diagrams and other supplementary material.—*Reviewed by* JOHN A. VOSKAMP, *New York.*

Uniform Building Code

UNIFORM BUILDING CODE, 1946 Edition—Adopted by Pacific Coast Building Officials Conference. 312 pp. Colling Publishing Co., Los Angeles 13, Calif. Cloth bound, $3; paper, $2.50.

Extensive revisions enable the "Uniform Building Code" to meet the demand for a code modern enough to recognize new materials and elastic enough to permit new uses of old materials. Every effort has been made to encourage ingenious and imaginative designers who wish to depart from the conventional.

The revised provisions concern administration, heavy timber construction, masonry, stairs and exits, chimneys, vents, fireplaces, motion picture projection rooms and heating appli-

ances. For the first time, a chapter on prefabricated construction has been incorporated, and in addition, new sections regulating glued construction have been added.

Developed in 1927 by the Pacific Coast Building Officials Conference, this "Uniform Building Code" now has been adopted by about 400 cities in 30 states, by eight counties and by two states. In its present form it is the result of 25 years of experience in building code writing on the part of enforcement officials. Besides containing model regulations and reliable information on building department procedures, it provides a workable plan for amendment to keep it in line with modern practice.

Data on Steel-Pipe Piles

SEAMLESS STEEL PIPE PILES—Design Manual No. 27. 82 pp. Prepared and published by the National Tube Co., Frick Building, Pittsburgh, Pa. Limited free distribution.

This is a real handbook of well presented information on how to determine the need for piles, their bearing capacity, value as columns and other essential data. The several current pile-driving formulas are reviewed with comments on application to pipe piles. Pile hammer data are presented with charts of resistance of soils to driving under different hammers using each of the several formula.

Being prepared by a manufacturer of seamless steel-pipe piles, much of the book relates to such piles. This in no way detracts from the value of the basic data included in this book and does give engineers and architects concise information on specifications for such piles, their bearing capacity and use in foundation work.

Miscellaneous Notes on Booklets and Reprints

HEAT LOSSES FROM SLAB FLOORS were measured in one of the current studies being made in the National Bureau of Standards. The results are contained "Building Materials and Structures Report BMS103" (Superintendent of Documents, Washington 25, D. C., price 10c.).

CONTRACTORS will find most of the answers to their questions about the use of pumps on construction jobs in "Contractors Pump Manual," published late last year by Contractors' Pump Bureau of the Associated General Contractors of America, Munsey Bldg., Washington, D. C. (Price 50c)

TO AID HOUSING AUTHORITIES in the difficult problem of assembling land, the National Housing Agency has issued a pamphlet entitled "Land Assembly for Urban Redevelopment" (National Housing Bulletin No. 3). Copies can be obtained from the Superintendent of Documents, Washington 25, D. C., for 10c.

THE PART PLAYED by the United States Steel Corporation in supplying war materials and war equipment has been put into permanent record form in a book called "Steel in the War". Statistics that could not be made public during the war show clearly the extent to which steel is essential to war.

New Engineering Books

SHEET PILING, COFFERDAMS AND CAISSONS—By Donovan H. Lee. 191 pp. Concrete Publications Limited, London, England. 10 shillings.

MANUAL FOR WATER PLANT OPERATORS—By A. A. Hirsch. 386 pp. Chemical Publishing Co., Brooklyn, N. Y. $6.50

THE ENGINEER IN SOCIETY—By John Mills. 196 pp. D. Van Nostrand Co., Inc., New York. $2.50.

PROFITABLE LABOR RELATIONS—By Paul Mooney. 209 pp. Harper & Bros., New York $2.50.

HACKH'S CHEMICAL DICTIONARY—Third Edition—By Julius Grant. 925 pp. The Blakiston Co., Philadelphia 5, Pa. $8.50.

UNIFORM BUILDING CODE—1946 Edition—Pacific Coast Building Officials Conference, 124 West 4th St., Los Angeles, Calif. Cloth bound $3.00; paper $2.50.

COUNSELING WITH RETURNED SERVICEMEN—By Carl R. Rogers and John L. Wallen. 156 pp. McGraw-Hill Book Co., New York 18, N. Y. $1.60.

CANOL—The Sub-Arctic Pipeline and Refinery Project Constructed by Bechtel-Price-Callahan for the Corps of Engineers, U. S. Army, 1942-1944—By Richard Finnie. 210 pp. Privately printed by Bechtel-Price-Callahan, 155 Sansome St., San Francisco, Calif.

Reports and Pamphlets

GEOLOGY AND GROUND-WATER RESOURCES OF THOMAS COUNTY, KANSAS—By John C. Frye. University of Kansas Publications, Bulletin 59, State Geological Survey of Kansas, Lawrence, Kansas.

CORROSION OF STEELS—Carnegie-Illinois Steel Corporation. U. S. Steel Corp., Pittsburgh 19, Pa.

REPORT AND RECOMMENDATIONS for the year ending Dec. 31, 1945—California State Reconstruction and Reemployment Commission, Sacramento, Calif.

A GUIDE TO THE LITERATURE ON THE HISTORY OF ENGINEERING available in the Cooper Union Library, New York 3, N. Y.

PROGRESS REPORT ON THE GROUND WATER RESOURCES OF PROVIDENCE, RHODE ISLAND—By Claude M. Roberts and Henry N. Halberg. Rhode Island Industrial Commission, Geological Bulletin No. 1, Providence, R. I.

WELL AND TEST HOLE RECORDS FOR PROVIDENCE, RHODE ISLAND—By Claude M. Roberts and Henry N. Halberg. Rhode Island Industrial Commission, Geological Bulletin No. 2, Providence, R. I.

THE PROPOSED AIRPORT FOR BROOME COUNTY, N. Y.—By Drew and Peters, Aviation Economics Consultants, Buffalo, N. Y.

ZUR ERD- UND KRIECHDRUCKTHEORIE—By Robert Haefeli. Verlag Ag. Gebr. Leemann & Co., Zurich, Switzerland. 6 francs (Swiss).

CALIFORNIA PLANNING—Based on annual report of city and county planninng commissions. State Reconstruction and Reemployment Commission, Sacramento, Calif.

GROUND WATER CONDITIONS IN THE VICINITY OF BATON ROUGE—Department of Public Works, Baton Rouge, Louisiana.

REPORT TO THE LEGISLATURE OF THE STATE OF NEW YORK—By the Joint Legislative Committee studying the Problem of Checking Erosion Along the North Shore of Long Island, Albany.

MISTAKES IN DRAINAGE—AND WHAT MAKES A SUBDRAIN—By H. E. Cotton, Armco Drainage & Metal Products, Inc., Middletown, Ohio.

A COMPREHENSIVE MUNICIPAL PLAN—LANCASTER, PENNSYLVANIA—By Michael Baker, Jr. The Baker Engineers, Rochester, Pa.

TRANSPORTATION REPORT-CENTRAL BUSINESS DISTRICT, TOLEDO, OHIO—Parsons, Brinckerhoff, Hogan & MacDonald, Consulting Engineers, New York 7, N. Y.

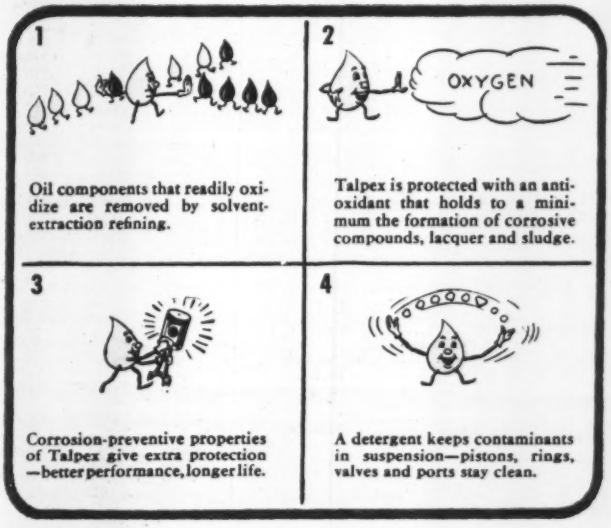
ALBANY WATERFRONT ARTERIAL HIGHWAY—Parsons, Brinckerhoff, Hogan & MacDonald, New York, Consulting Engineers, New York 7, N. Y.

CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES—American Institute of Steel Construction, 101 Park Ave., New York 17, N. Y.

ANNUAL REPORT OF THE SECRETARY OF THE INTERIOR—Victory Edition. Superintendent of Documents, Washington 25, D. C., 50c.

NEW YORK ADVANCING—A consolidated report of all city departments. Municipal Reference Library, Municipal Bldg. New York, $1.00.

THESE FOUR *TALPEX* PERFORMANCE FACTORS SAFEGUARD HIGH-SPEED DIESELS


1
Oil components that readily oxidize are removed by solvent-extraction refining.
2
OXYGEN
Talpex is protected with an anti-oxidant that holds to a minimum the formation of corrosive compounds, lacquer and sludge.
3
Corrosion-preventive properties of Talpex give extra protection—better performance, longer life.
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A detergent keeps contaminants in suspension—pistons, rings, valves and ports stay clean.

OF COURSE, you know that no oil will last forever in a Diesel. But do you know that Old Man Oxygen, after years of easy wins over ordinary oils, gets the surprise of his life with Shell Talpex?

That's because Talpex is doubly protected against oxidation to retard the formation of corrosive compounds, sludge and lacquer.

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The Shell Lubrication Engineer will give you sound advice about the lubrication of *any* type of Diesel, whether slow, medium, or high speed. Write for a copy of Shell's booklet, "The Fundamentals of Diesel Lubrication." Shell Oil Company, Incorporated, 50 West 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, California.

SHELL

SHELL DIESEL LUBRICANTS

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

WOLF CREEK DAM
CUMBERLAND RIVER, KENTUCKY

OWNER: War Dept., U. S. Engineers, Nashville, Tenn.

PROJECT: The construction of Wolf Creek Dam, a combination concrete and earth dam located on the Cumberland River at mile 460.9 in Russell County, Kentucky, approximately 10 miles southwest of Jamestown, Kentucky, and 12 miles north of Albany, Kentucky. The site is served by right and left bank access roads connecting with highway No. 35 which runs through both Jamestown and Albany, Kentucky. Railroad facilities are available at Jamestown, Tennessee, (Oneida and Western Railroad) a distance of 42 miles and at Somerset, Kentucky (Southern Railway) which is about 52 miles from the site. The work for this project is authorized by the Flood Control Act approved June 28, 1938. Work includes: Cofferdams for earth embankment; masonry construction, unwatering, maintenance and removal; foundation work, excavation, foundation drilling and grouting; earth embankment, earth fill, stonework, drainage and roadway surfacing; concrete masonry for concrete dam, pylon, spillway bridge, spray, training and retaining walls, piers, powerhouse substructure and appurtenant works; penstocks, power and lighting systems, elevator, bulkheads.

CONDITIONS: Contractor to furnish all plant, materials, equipment and supplies, labor and transportation, including fuel, power, water (except some materials furnished by the Government) and to complete all work within 1,000 calendar days.

BIDS: Six bids were received at 11:00 AM, February 5, 1946, at Nashville, Tennessee ranging from the contract low of $18,395,934.50 to $23,722,071.00.

1. J. A. Jones Construction Company, Inc., Charlotte, N. C., and Wright Contracting Co., Columbus, Ga., a joint venture. (contract) . $18,395,934.50
2. S. A. Healy and Company, and Material Service Corporation Chicago, Ill. $19,933,822.30
3. Wolf Creek Constructors, Dallas, Texas, a joint venture of ten firms. $20,386,386.00
4. Morrison-Knudsen Co., Inc., Boise, Idaho . . . $22,960,301.00
5. Wolf Creek Constructors, Kansas City, Missouri, a joint venture of five firms. $23,094,544.50
6. Foley Brothers, Inc., Pleasantville, New York $23,722,071.00

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Cofferdams	Job	$314,000.00	$620,000.00	$533,427.00
3. Excavation, Common	1,380,000 cu. yd.	.38	.59	.50
4. Excavation, Rock	158,000 cu. yd.	2.75	3.65	2.25
5. Line Drilling	15,000 sq. ft.	1.25	2.23	2.00
6. Excavation, Borrow Area "A"	3,500,000 cu. yd.	.334	.52	.38
7. Excavation, Borrow Area "B"	3,100,000 cu. yd.	.296	.51	.38
8. Excavation, Borrow Area "C"	1,150,000 cu. yd.	.409	.54	.40
9. Foundations, Cleanup	70,000 sq. yd.	1.50	1.57	2.00
10. Drilling 2" Grout Holes Under Embankment	300 lin. ft.	2.90	2.82	2.20
11. Drilling 2" Grout Holes Under Masonry	57,000 lin. ft.	2.90	2.96	2.20
12. Drilling 4" drain Holes	7,000 lin. ft.	4.70	4.75	3.35
13. Drilling 2" Drain Holes (Percussion)	1,950 lin. ft.	3.75	1.38	.70
14. Drilling 3" Anchor Holes (Percussion)	6,800 lin. ft.	3.75	1.38	.80
15. Drilling 6" Core Holes	200 lin. ft.	8.30	8.26	6.00
16. Pressure Grouting Under Embankment	100 sack of cmt.	1.20	1.38	1.10
17. Pressure Grouting Under Masonry	45,000 sack of cmt.	1.20	1.38	1.10
18. Impervious Rolled-Fill	6,900,000 cu. yd.	.058	.07	.14
19. Random Fill	232,000 cu. yd.	.03	.055	.10
20. Backfill	32,000 cu. yd.	.90	.69	1.40
Two Trips	2,000,000 sq. ft. (100 sq. ft.)	.012	.001	.03
23. Sand and Gravel	50,900 cu. yd.	2.16	.90	1.50
24. Riprap Dumped	150,600 cu. yd.	1.83	4.00	3.00
25. Rock Paving	4,500 cu. yd.	9.00	25.50	15.00
26. Rockfill	21,000 cu. yd.	3.50	4.80	2.40
28. Vitrified Tile, ½ Round 12"	3,200 lin. ft.	1.00	1.03	2.00
29. Seeding	46 Acre	400.00	645.00	350.00
30. Roadway Gage	22,000 sq. yd.	1.50	1.58	1.20
31. Roadway Guard Rail	9,200 lin. ft.	2.50	2.75	2.00
32. Corrugated Metal Pipe 10"	910 lin. ft.	3.00	3.45	3.00
33. Corrugated Metal Pipe 12"	580 lin. ft.	4.00	4.20	3.50
34. Corrugated Metal Pipe 15"	150 lin. ft.	5.00	5.00	4.50
35. Corrugated Metal Pipe 21"	1,970 lin. ft.	6.00	6.60	6.00
36. Corrugated Metal Pipe 24"	460 lin. ft.	8.00	7.60	7.00
37. Catchbasin, Complete	20 each	100.00	260.00	200.00
38. Hauling and Storing Cement	1,400,000 Bbl.	.40	.88	.60
39. Concrete, Dam	1,250,000 cu. yd.	7.42	6.10	7.50
40. Conc., Piers, Spray Walls	11,800 cu. yd.	15.30	13.55	22.00
41. Concrete, Training and Retaining Walls	36,400 cu. yd.	11.75	9.00	12.00
42. Concrete, Bridge	640 cu. yd.	51.50	36.50	55.00
43. Concrete, Miscellaneous	4,500 cu. yd.	38.50	49.00	55.00
44. Pylon	Job	42,600.00	46,800.00	50,000.00
45. Reinforcing Steel	2,400,000 lb.	.0775	.085	.09
46. Porous Concrete Pipe	38,000 lin. ft.	.785	.70	1.40
47. Copper Stops	31,000 lb.	.78	.70	.90
48. Slide Gates	Job	18,230.00	50,500.00	50,000.00
49. Oil Pumps and Piping Sys.	Job	35,600.00	18,000.00	33,000.00
50. Sluice Bulkhead and Pickup Beam	Job	3,000.00	3,450.00	4,000.00
51. Tainter Gate Emb. Metal	Job	23,200.00	81,000.00	70,000.00
52. Penstocks	1,610,000 lb.	.182	.21	.18
53. Structural Steel	795,000 lb.	.12	.12	.14
54. Miscellaneous Metal Work	295,000 lb.	.31	.26	.30
55. Cast Iron, Miscellaneous	85,000 lb.	.58	.41	.20
56. Wrought Iron, Miscellaneous	98,000 lb.	.38	.30	.30
57. Brass and Bronze, Misc.	2,200 lb.	1.00	.83	1.50
58. Handrailing	55,000 lb.	.42	.34	.25
59. Pipe, Black Steel	207,000 lb.	.20	.17	.15
60. Pipe, Misc. Corru. Metal	18,500 lb.	.16	.25	.20
61. Sump Pumping System	Job	6,800.00	7,600.00	4,500.00
62. Raw Water Supply System	Job	4,200.00	4,500.00	5,000.00
63. Grouting Gallery Water Sys.	Job	4,000.00	1,900.00	2,000.00
64. Bypass Systems	Job	20,000.00	27,500.00	20,000.00
65. Floatwell Piping System	Job	3,900.00	3,800.00	3,500.00
66. Pylon Plumb. and Drain. Sys.	Job	4,650.00	3,700.00	3,500.00
67. Piesometer System	Job	3,000.00	3,300.00	1,500.00
68. Elevator	Job	22,350.00	22,000.00	20,000.00
69. Trashrack Cleaning Pipe Sys.	Job	11,700.00	3,000.00	30,000.00
70. Power and Lighting System	Job	118,700.00	48,000.00	80,000.00
71. Conduit for Electric Wiring	Job	59,000.00	82,000.00	50,000.00
72. Tile Gages	Job	2,200.00	700.00	2,000.00
73. Tainter Gates	Job	70,300.00	90,000.00	70,000.00
74. Tainter Gate Oper. Mach.	Job	29,300.00	37,000.00	20,000.00
75. Intake Gates and Hoists	Job	28,500.00	60,000.00	35,000.00
76. Crushed Stone	1,700 cu. yd.	4.50	4.50	3.50

POWERHOUSE SUBSTRUCTURE ITEMS

1. Excavation, Common	23,000 cu. yd.	1.00	.59	.50
2. Excavation, Rock	36,500 cu. yd.	5.14	3.92	3.00
3. 6"Porous Conc. Pipe Half Rnd.	3,350 lin. ft.	.50	.55	1.50
4. Line Drilling	40,000 sq. ft.	1.25	2.23	2.00
5. Drilling 2" Grout Holes Under Masonry	2,000 lin. ft.	2.90	2.95	2.20
6. Pipe, Black Steel	20,500 lb.	.20	.17	.15
7. Press. Grout. Under Masonry	2,300 sack of cmt.	1.20	1.38	1.10
8. Drilling 3" Drain Holes	650 lin. ft.	3.75	1.38	3.20
9. Backfill	16,000 cu. yd.	.90	1.13	1.40
10. Concrete, Foundations	32,000 cu. yd.	14.30	10.16	13.00
11. Concrete, Walls	3,400 cu. yd.	32.00	33.48	42.00
12. Reinforcing Steel	1,900,000 lb.	.0775	.085	.09
13. Copper Water Stops	4,000 lb.	.80	.70	.90
14. Steel Water Stops	11,800 lb.	.10	.14	.50
15. Structural Steel	62,100 lb.	.12	.12	.14
16. Misc. Metal (Embedded)	23,000 lb.	.31	.26	.30
17. Steel Doors Embed. Metal	1,600 lb.	.25	.34	.30
18. Draft Tube Gates Embedded Metal	50,000 lb.	.07	.34	.20
19. Draft Tube Unwatering Sys. Piping and Embed. Metal	79,000 lb.	.35	.20	.14
20. Station Drainage System C.I. Pipe and Embed. Metal	118,000 lb.	.35	.20	.15
21. 8" Vitrified Clay Pipe B & S.	650 lin. ft.	1.40	.83	1.50
22. 3" Vitrified Clay Pipe B & S.	400 Lin. ft.	1.05	.62	1.00
23. Generator Cooling Water Sys. Piping, Embed. Metal	12,500 lb.	.38	.20	.20
24. Sewage Disp. System Piping	2,000 lb.	.38	.20	.20
25. Tailwater Gauge Piping	900 lb.	.40	.20	.20
26. Turbine Free Air Sup. Piping	8,200 lb.	.36	.30	.30
27. Hosing on Draft Tube Pier	12 each	300.00	345.00	250.00
28. Station Ground Grillage	310 lb.	1.00	.83	1.00
29. Embedded Elect. Mat	3,050 lb.	.75	.83	1.00

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- **Painting.**
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- **Spraying railroad tunnels to protect roof from smoke acid.**
- **Spraying rust preventative on machinery.**

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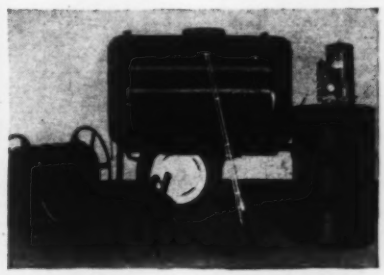


Alemite Versatal outfits include the Versatal pump, 2-wheel or skid-mounted air compressor, reel, hose and hose roller, and pole gun.

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

CONSTRUCTION MATERIAL and labor rates in April as reported to *Engineering News-Record* reveal several changes from the preceding month. The recent revision of steel prices by the OPA is reflected in April by eleven of the ENR cities recording price increases on this material ranging from $4.00 to $5.00 per ton; while a number of steel products are not yet assigned a definite price increase by the OPA, this is expected shortly. OPA increases for Douglas fir and yellow pine continue to be reflected in this month's ENR prices pages, but the lumber situation continues to be very tight throughout the country. Reports state that asphalt prices have increased; only New York City reflects a price increase in this material this month. Chicago, Minneapolis and New York all report increased prices this month for both fir and pine lumber. In Baltimore, structural clay tile price increased $5.00 per M. this month. In New York City, ENR sources have stopped quoting prices for 8-10-12x12x12 structural clay tile-load bearing and have substituted 7⅝x7⅝x12 speedtile at $156.60 per M. pieces. Also noted is that the prices for structural clay tile products including speedtile in New York City are subject to increase not to exceed 15 percent of the prices quoted for shipments made by December 31, 1946 and thereafter, to prices in effect at the time of shipment.

Eight cities reported wage increases this month for both skilled and common labor. The result of the increases made to common labor during the past few months sends ENR common labor average over the $1.00 mark for the first time on record. Cincinnati, Cleveland and San Francisco increased wages for all construction men, skilled and common this month.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F. O. B. CITY

	PORTLAND CEMENT			SAND AND GRAVEL			CRUSHED STONE		CRUSHED SLAG		CONCRETE BLOCK		CONCRETE
	Per bbl., C/L lots, incl. 40c. per bbl. for bags, cash dis. not deducted			Per ton, carload lots			Per ton, carload lots		Per ton, carload lots, f.o.b. plant		8x8x16-in.; truckload del.; per block		Ready Mixed 1:2:4, over
	Cloth *a*	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand-grav.	Lt.wgt. Agg.	50 c.y., del.
Atlanta	$2.77	$2.52	$2.43	$1.79	$1.89	$1.65	$1.79	$1.89	$1.59	$1.69	$0.17	....	$8.30
Baltimore	2.62	2.37	2.12	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.75‡	1.75‡	.125	$0.125*w*	7.45
Birmingham	2.50	2.25	2.10	1.75	1.75	1.50	.85	1.00	.90	1.15	.1425	....	5.95
Boston	2.79*b*	2.72*b*	2.52	1.50‡	1.50‡	1.05‡	1.25‡	1.35‡	....	....	.13	.155*w*	7.55*m*
Chicago	2.90	2.65	2.50	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	1.75‡	1.75‡	.18	.18*x*	....
Cincinnati	2.51	2.26	2.06	1.20	1.20	1.10	1.80	1.80	....	....	.13	.17*w*	6.85
Cleveland	2.59	2.34	2.19	1.75*i*	1.75*i*	1.25/1.65*i*	1.80*i*	1.80*i*	1.15	1.15	.14	.14	8.15
Dallas	2.51	2.26	2.06	1.80*p*	1.80*p*	1.45*p*	1.72*p*	1.82*p*	....	....	.15	....	8.20
Denver	4.00	3.40	2.47	1.20	1.25	.90	1.65	1.75	1.00	1.00	....	.15	8.75
Detroit	2.59	2.34	2.16	1.75	1.75	1.55	2.25	2.25	2.00‡	2.00‡	.14	.15*w*	7.15
Kansas City	2.78	2.57	2.38	1.85	2.30	1.00	1.91	1.91	....	....	.16	.16*wy*	7.80*n*
Los Angeles	3.00*v*	2.40*v*	....	1.30	1.30	1.15	1.30*f*	1.30*f*	....	....	.04*bb*	.075*aa*	7.25
Minneapolis	3.10	2.85	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	.14	....	7.60*j*
Montreal	....	1.95*r*	1.79*r*	1.65‡*s*	1.65‡*s*	1.50*t*	.80*ct*	.90*ct*	....	....	.1999	.17*wt*	7.00*ls*
New Orleans	2.41	2.16	1.92	1.67	1.65	1.22	....	....	.90	1.15	.19	....	9.25
New York	2.85‡	2.60‡	....	1.60*de*	1.60*de*	.90*de*	1.80*de*	1.80*de*	....	....	.16	.14*wcc*	8.25*kq*
Philadelphia	2.73‡	2.48‡	2.28‡	1.55‡	1.65‡	1.20‡	1.90‡	1.95‡	1.10	1.10	.155	.155*w*	8.55
Pittsburgh	2.80	2.55	2.35	1.65‡	1.65‡	1.85‡	2.25‡	2.25‡	1.50	1.50	.17	.17*z*	8.55
St. Louis	3.08	2.80	....	1.75‡	1.75‡	1.65/1.75‡	1.25/2.00	1.25/2.00	.90*g*	1.15*g*	.155	.18*y*	8.60
San Francisco	2.21	2.01	1.71	1.36	1.36	1.36	1.46	1.46	....	....	....	.215*y*	7.55
Seattle	....	2.75*o*	....	2.35‡*d*	2.35‡*d*	2.35‡*d*	2.85‡*od*	2.85‡*od*	....	....	.16	....	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *q* 5 cu. yds. or more. *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* Withdrawn. *v* 20c. per bbl. discount; 80c. per bbl. for bags. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 x 18 in.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

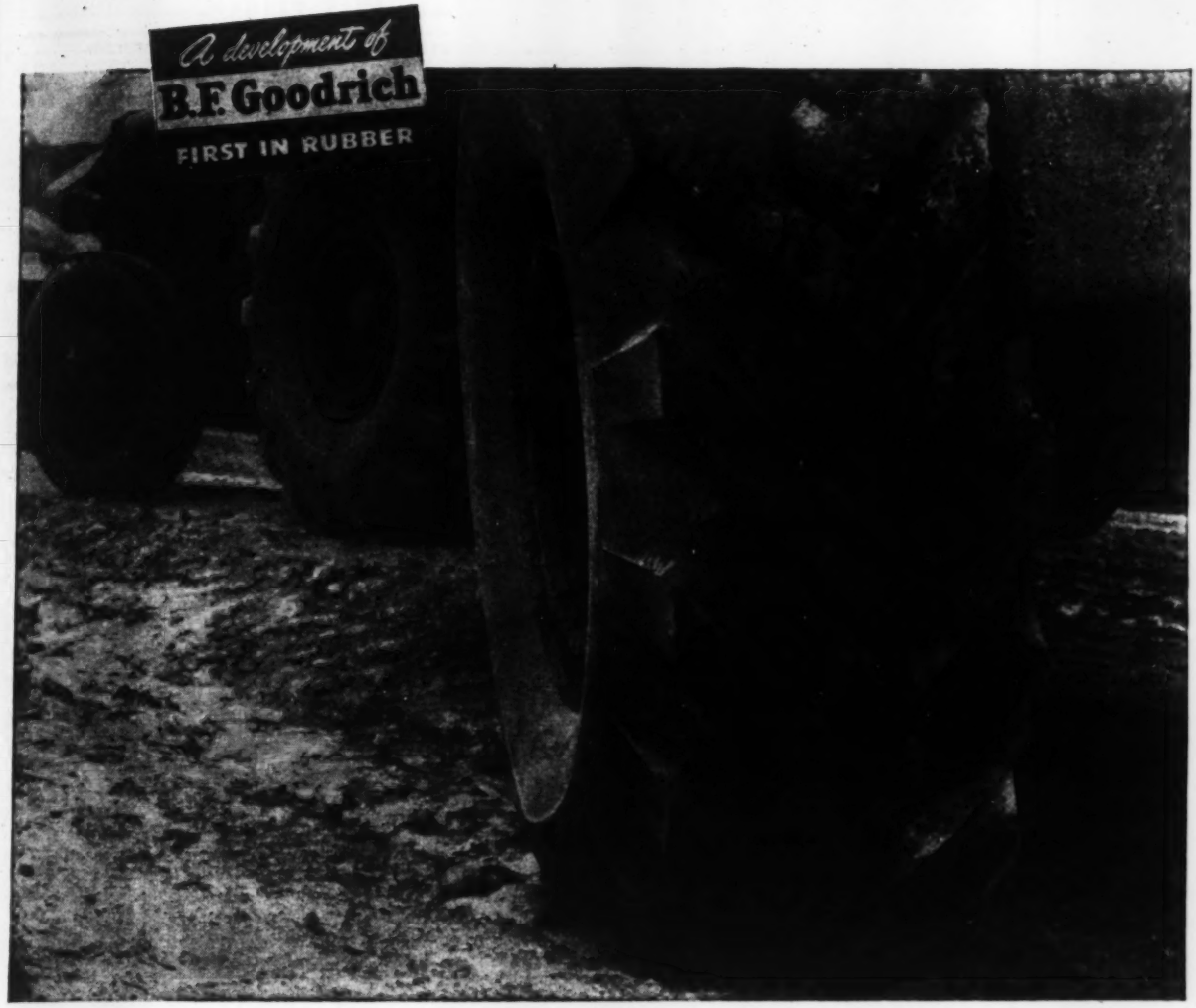
	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.90	$1.85	Ironton, Ohio	$1.80*	$1.75*	Richard City, Tenn	$1.90	$1.85
Dallas, Tex	....	....	Limedale, Ind	....	....	Steelton, Minn	2.00	1.95
Hannibal, Mo	1.90	1.85	Norfolk, Va	....	....	Universal, Pa	1.85	1.80
Hudson, N Y	....	....	Northampton, Pa	1.75	1.70	Waco, Tex. (Plus 9c. tax in Tex.)	1.75	1.70
Independence, Kans	1.90	1.85	North Birmingham, Ala	....	....	Montreal City (Discount 10c. per bbl. 20 days)	1.68	1.67

* Destination price base; effective Sept. 17, 1945.

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OIL	ASPHALT EMULSION (Quick-breaking)	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Per ton, less than 80 penetration		Per gal., 80–300 penetration		Per ton		Per gal.	Per gal.	
				Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	.....	$2.25	.....	$14.00	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	49.00	85.00*m*	15.00*r*	21.00*r*	.06*r*	0.09*r*	13.00*r*	23.00*r*	.06*r*	.07*r*	.14*r*
Birmingham	150.00	32.00*j*	.....	17.95	.....†	.0747	.....†	.0834*h*	.....†	.065	.095	.....†
Boston	85.00	59.00	3.75	15.00	24.00	.0625	.115	17.00	30.00	.0625	.0825	.145
Chicago	150.00‡	60.00*e*‡	2.85/4.00*d*	14.00	22.50	13.00*g*	21.50*g*	.0575*h*	.15*h*	.05*n*	09/.10*n*	.13/.15*n*
Cincinnati	120.00	55.75	.....	17.00	.....	.085	.....	12.25	.....	.07	.085	.....
Cleveland	120.00	39.00	3.87	17.00	19.00	.085	.095	.10*h*	.11	.08	.10	.....
Dallas	.....	40.00	.....	13.65	20.30	.06	.11	16.00	24.80	.06	05/.07	.07/.09
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	37.00	.....	17.60*f*	26.56*f*	.0734	.128	.0718*h*	.119*h*	.067	.0974	.135
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	9.00*b*	23.00*b*	9.50*bg*	24.00*bg*	9.50*b*	.....	.025*b*	.072*b*	.15*b*
Minneapolis	.....	.....	2.017*d*	.....	27.70	.....	.126	.....	32.64	.....	.....	.....
Montreal	70.00	.....	.....	16.60*k*	24.25*k*	.1035*k*	.111*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	.....	.....	.....	13.50*a*	20.00*a*	.057	.088	.06*h*	.095*h*	.....	.080	.....
New York	.....	65.00	.....	18.56	25.35	15.15	.....	.073*h*	.133*h*	.0675	.075	.1240
Philadelphia	150.00	62.00	4.06	15.00	.....	14.00/15.00	.....	.0625*h*	.....	.....	14.00*gr*	.....
Pittsburgh	135.00	39.75	3.75	18.00	23.00	.09	.16	20.00	36.00	.07	.08	.13
St. Louis	.....	40.00	.....	14.80	19.80	13.80*g*	18.80*g*	.0587*h*	.1362*h*	.483	.07	.1215
San Francisco	.....	45.00	.....	10.90	20.15	10.90*g*	.....	12.90	.....	.....	.0525	.1125
Seattle	.....	.....	.....	10.90*i*	21.90*i*	.....	20.40*gi*	11.40*i*	13.90	10.90	.0525*i*	.0625*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 3½ x 4 x 8½ in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½ in. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3 x 3½ x 8½ in. *k* Tax included. *l* F.o.b. Toledo. *m* Per thousand. † Available in drums—quoted on request only. *r* February 1943 prices, none later available.



It floats as it grips — it's built with greater bruise resistance

BUILDERS of roads, dams, airports, and others who have to work in soft dirt, sand, and loam had plenty of special tire problems. For instance, tires often mired, losing valuable time. Wheels would spin and tires might be cut by sharp rocks. And tires took a beating when they hit rocks and ruts —because every "hit" is an impact that often leads to bruises and blow-outs. Resulting delays and repairs eat into profits.

B. F. Goodrich engineers studied all the angles, and came up with a new kind of tire... the Super-Traction (shown above). First, they solved the "miring" problem with a special self-cleaning tread that has enlarged contact area to provide maximum flotation. The heavy cleats give a deep bite —without bogging down or slipping. The body is flexible but strong.

The other big problem—greater bruise resistance—was solved with a new kind of construction principle —the *shock shield*. This shield, an exclusive B. F. Goodrich feature, is a set of four breakers—layers of rubber-coated rayon cords—built in between the tread and the plies. The breakers are in pairs, with the cords in each pair running parallel to each other—but with each pair running in opposite directions to give balanced strength. The breakers are cushioned with thick layers of shock-resistant rubber.

Under impact, the cords in the breakers stretch together—*not* across each other, and return to their original position. The blow is *distributed* and *absorbed* by the rubber cushions—the shock passed on to the cord body is greatly reduced.

Tires built with these B. F. Goodrich advantages are helping users get far greater service. They report fewer bruises, far less ply separation, longer wear, better traction. Repair bills are lower. Delays are reduced.

You can make similar savings with the Super-Traction—or with other B. F. Goodrich off-the-road tires designed to meet needs just like yours. See the B. F. Goodrich dealer, or write us direct. *The B.F.Goodrich Company, Akron, Ohio.*

Truck Tires BY

B.F. Goodrich

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std Spikes *e*	Tie Plates *e*	Track Bolts
Birmingham	$2.10	$2.15	$3.75	$2.90	....	$43.00	$45.00	$45.00	$2.70	$3.00	$2.15	$4.75
Chicago	2.10	2.35	3.75	3.25	$2.40	43.40	9.18	50.00*	2.85	3.65	....	4.75
Pittsburgh	2.35	2.35	3.75	3.25	2.40	43.40	9.18	9.18*	2.85	3.65	2.55	4.75
Buffalo	2.10	2.15	....	....	2.40	.....	.....	.....	....	....	2.30	....
Cleveland	2.10	2.15	3.75	2.90	....	.....	.....	.....	....	....	....	....
Youngstown	....	2.15	....	....	....	.....	.....	.....	....	3.25	....	....
Detroit	....	2.27‡	....	....	....	.....	.....	.....	....	....	....	....
Gulf ports	2.47*a*	2.52*a*	....	....	2.85*a*	.....	.....	.....	....	....	....	....
Pacific ports	2.75*a*	2.80*a*	....	3.40	2.95*a*	.....	.....	.....	....	....	....	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per cl. * Per net ton.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS* Per 100 lb., ¼ in., base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires *k* Per 100 s. f.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.40	$2.40	$.02½	$.10	$21.06	$23.00	$1.82	$1.35	$1.91	$3.04
Baltimore	3.70	2.90	2.75	....	.10	23.00	25.00	1.70	1.27	1.79	3.00
Birmingham	2.10*a*	2.15	2.15	.02½	.10	19.00	21.00	1.80	1.34	1.89	....
Boston	4.162‡	4.194‡	....	$20 C.L.	.10	18.50	29.50	1.76	1.31	1.84	3.02
Chicago	2.35*a*	2.35*a*	2.35*a*	.03	.05	21.50‡	23.50	1.67	1.25	1.75	2.65
Cincinnati	3.68	2.66*cd*	2.66*cd*	....	.05	19.50	21.50	1.66	1.25	1.74	....
Cleveland	3.588*k*	3.10*k*	3.10*k*	.02½	.10	20.50	24.50	1.66	1.25	1.74	....
Dallas	4.25	3.17	3.17	....	....	25.50	27.50	1.93	1.42	2.03	....
Denver	4.577	4.34	4.25	....	....	28.00	.....	1.97	1.45	2.07	....
Detroit	3.911‡	2.70‡	2.70‡	....	.10	25.00	30.00	1.68	1.26	1.76	2.91
Kansas City	4.44	2.75*cd*	2.75*cd*	.0	.05	25.50	27.50	1.78	1.33	1.87	3.062
Los Angeles	4.45*f*	3.025	2.487	.02½	.05	23.00	27.50	1.93	1.42	2.03	4.45
Minneapolis	4.122‡	2.99	2.99	.0	.10	21.00	23.00	1.80	1.34	1.89	3.04*d*
Montreal	3.95*i*	2.90*i*	2.80*i*	....	....	31.00*hi*	46.00*hi*	2.76	3.44*i*	2.82*im*	....
New Orleans	4.408‡*k*	3.84*k*	4.108	.05	.10	22.00	24.00	1.82	1.35	1.91	3.125
New York	4.008	2.96*c*	2.96*c*	....	.15	17.50	19.50	1.72	1.29	1.81	2.74
Philadelphia	3.666	3.668	....	....	....	20.50‡	22.50‡	1.71	1.28	1.79	2.72
Pittsburgh	2.35*a*	2.35*a*	2.35*a*	.02½	.10	23.00	26.50	1.59	1.20	1.67	2.65
St. Louis	3.697	2.74	2.74	.0	.05	28.00	34.00	1.69	1.27	1.78	2.70
San Francisco	4.60	3.025	2.875	.02½	.10	21.00	24.50	1.93	1.42	2.03	3.20
Seattle	3.00*e*	3.00*e*	....	....	....	34.50	38.50	1.93	1.42	2.03	3.20*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *k* Quotation on changed basis; no actual price change. *m* Per sq. yd.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, std. 8 in., s.s.	Delivered std. 12 in., s.s.	ASTM 24 in.	C13–35 36 in.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in.; Lap Weld Black %	Galv. %
Atlanta	$56.40	$0.43*b*	$0.67	$3.39	....	$110.00	$140.00	$0.45	$2.00	48.2	54.2	59.7	51.2
Baltimore	60.80	.35	.60	2.70	$7.25	160.00	200.00	.75	2.00	65.5	57.5	63.0	54.5
Birmingham	52.00	.275	.495	1.95	5.50	100.00	220.00	.50	1.75	62.2	54.2	59.7	51.2
Boston	63.00	.392*r*	.756*r*	3.15*r*	7.995*r*	170.00‡*r*	265.00‡*r*	.46*t*	1.77*t*	....	....	....	....
Chicago	60.80	.40	.675	2.70	7.00	110.00‡	150.00‡	.45	1.85	63.0	52.0	61.5	50.0
Cincinnati	59.80	.308	.594	3.42	8.20	97.30	149.40	.36	1.60	57.1	43.4	54.0	39.6
Cleveland	61.20	.266*r*	.513	2.15	5.535	90.60	139.40	.36	1.60	68.5	57.5	66.0	54.5
Dallas	62.78	.365	.657	2.664	6.00	108.00	130.00	.46	1.57	....	....	....	....
Denver	67.62	.32	.576	2.376	....	143.00‡	264.00‡	.52	2.00	48	35	44	30
Detroit	61.20	.42	.81	3.15	8.50	170.00‡*r*	263.00‡*r*	.36	1.60	54.1	40.3	50.9	36.5
Kansas City	62.12	.35	.59	2.20	6.20	160.00	286.00	.45	1.60	37.88	48.40	48.70	61.93
Los Angeles	74.00	.325†	.585†	2.70	6.75	130.50	217.50	1.00†	2.00†	60.6	49.6	57.9	46.4
Minneapolis	64.10	.305†	.549†	2.196†	6.25†	....	....	.90	2.40	64.2	53.2	60.7	49.2
Montreal	67.00	.85*o*	1.50*o*	5.25*p*	8.50*ep*	45.00*m*	64.00*m*	.811*m*	2.51*m*	....	....	....	....
New Orleans	58.40	.37*r*	.78	1.69	....	150.00	220.00	.45	1.65	62.4	54.4	58.8	50.3
New York	60.20	.38	.75	3.06	7.88	....	....	.60	1.40	61.9	50.9	59.4	47.9
Philadelphia	58.90	.385	.75	3.06	8.00	180.00	250.00	.45	1.75	56.6	42.8	53.6	39.1
Pittsburgh	61.60	.287†*r*	.5535†*r*	2.475†*r*	6.4575*r*	124.20	193.80	.99	2.25*g*	68.5*i*	57.5*i*	66.0*i*	54.5*i*
St. Louis	59.40	.31	.558	2.232	4.95	93.50	187.00	1.00*j*	2.15*k*	68.5	57.5	66.0	54.5
San Francisco	74.00	.3875*d*	.6975*d*	2.79	6.975	124.50	207.50	.58	2.34	45.0	31.0	41.0	26.0
Seattle	75.80	.4125	.77	2.98	....	115.20	....	.51*f*	1.44*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, Burlington, N. J. (base) $57.00. Based on existing freight rates; subject to rate change. Gas pipe and class A. $3 per ton additional, 4 in., $5 per ton additional, 30 in. and larger usually $1 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.; ¼ in., 8½c.; ½ in., 11½c.; 1 in., 17c.; 2 in.. 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 per cent tax on transportation costs not included. *i* Applies also at Lorain, Ohio mills Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh. Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt-weld—1 in. and 1¼ in. black 34 galv. 16; 1½ in. black 38 galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in. black 31½ galv. 14½; 4½ in.: to 8 in black, 32½ galv. 17. *j* Reinforced; spec. C 76–37. *k* Reinforced; spec. C 75–37. *l* Plus sales tax. *m* Centri. spun. *n* 27-in. pipe. *o* Less 50%. *p* Less 53%. *r* Truck delivery. *t* Full truck load lots. *u* Scarce: carload quantities not readily available.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) · All Fir planks No.2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	1x6 Std	1x8 Std	2x4 Std	2x6 Std	2x8 Std	2x10 Std	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	3/8"	1/4"
Atlanta	**$41.00**	**$41.00**	**$35.50**	**$38.50**	**$37.50**	**$41.50**	**$45.00**	.....	.....	**$60.50**	**$64.00**	**$17.90**	**$21.85**
		35.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baltimore	**48.00**	**50.00**	**48.00**	**50.00**	**51.00**	**56.00**	**70.00**	.....	.....	125.00	130.00	18.25	22.25
	52.00	*53.00*	*59.00*	*59.00*	*59.00*	*62.50*	*75.00*	*$80.00*	*$80.00*	.....	.....	.....	.....
Birmingham	**50.00**	**50.00**	**49.50**	**48.50**	**49.50**	**52.50**	**73.00**	.....	.....	.....	.....	17.35	21.15
[1]	55.00	55.00	54.50	53.50	54.50	57.50	77.00	60.00	61.00	72.50	75.00	.....	.....
Boston	60.00[2]	60.00[2]	60.00[2]	60.00[2]	60.00[2]	62.00[2]	66.00[2]	.....	.....	.....	.....	18.25	22.25
	55.00	*55.00*	*54.00*	*54.00*	*54.00*	*54.00*	*58.00*	*58.00*	*58.00*	*58.00*	*58.00*	.....	.....
Chicago	**60.00**	**61.00**	**57.00**	**57.00**	**57.00**	**64.00**	**70.00**	.....	.....	92.00*l*	92.00*l*	14.60	17.80
	55.00	*55.00*	*56.00*	*56.00*	*56.00*	*57.00*	*58.00*	*58.00*	*59.00*	.....	.....	.....	.....
Cincinnati	**47.50**	**49.00**	**42.50**	**42.50**	**44.50**	**52.50**	**67.00**	.....	.....	65.00	65.00	17.35	21.15
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	**42.50***k*	**42.50***k*	**52.50***k*	**51.00***k*	**65.00**	**65.00**	**83.00**	**83.00**	**83.00**	.....	.....	17.75	21.60
Dallas[e]	**45.25**	**45.25**	**44.50**	**43.00**	**43.00**	**47.25**	**60.75**	**58.75**	**58.75**	88.75	85.00	14.60	17.80
Denver[‡]	64.25[4]	64.25[4]	64.75[4]	65.25[4]	63.75[4]	64.75[4]	68.75[4]	*72.00*	*72.25*	.....	.....	10.45	12.70
Detroit	**61.00**	**61.00**	**57.75**	**57.75**	**57.75**	**63.75**	**71.00**	.....	.....	70.75	90.00	17.35	21.15
	57.00	*57.00*	*57.00*	*57.00*	*62.75*	*72.75*	*75.00*	*75.00*	*90.00*	.....	.....	.....	.....
Kansas City[a]	**69.00**	**69.00**	**67.00**	**65.50**	**67.00**	**69.00**	**84.00**	.....	.....	84.00	94.00	12.60	15.40
	66.00	*66.00*	*59.50*	*59.50*	*59.50*	*59.50*	*75.00*	*80.00*	*80.00*	.....	.....	.....	.....
Los Angeles[a]	*60.00*	*60.00*	*60.50*	*60.75*	*59.25*	*59.25*	*72.75*	*72.00*	*72.00*	.....	.....	9.90*gh*	12.05*gh*
Minneapolis[‡b]	72.50[3]	71.25[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.60	15.40
[‡]	*71.00*	*71.00*	*72.50*	*72.75*	*71.50*	*73.75*	*72.50*	*75.50*	*75.75*	.....	.....	.....	.....
Montreal[†7]	*64.00*	*65.00*	*60.00*	*63.00*	*65.00*	*70.00*	.....	.....	.....	.....	.....	.....	.....
	90.00	*90.00*	*90.00*	*90.00*	*90.00*	*90.00*	*80.00*	*82.00*	.....	.....	.....	.....	.....
New Orleans	**42.00**	**42.00**	**39.00**	**38.50**	**34.00**	**42.00**	**46.00**	.....	.....	54.50	69.00	14.60	17.80
	30.50	*30.50*	*30.00*	*30.00*	*29.00*	*29.00*	*28.50*	*29.50*	*29.50*	.....	.....	.....	.....
New York	[Range from **$75.00** to **$85.00**]						[**$80** to **$85**]	.....	.....	120.00*f*	125.00*f*	18.35	22.25
[‡]	.....	.....	*80.00i*	*80.00i*	*80.00i*	*80.00i*	[Range from *$80* to *$97.50*]			.....	.....	.....	.....
Philadelphia	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	**75.00**	.....	.....	130.00	130.00	18.25	22.25
	75.00	*75.00*	*75.00*	*75.00*	*75.00*	*75.00*	*85.00*	*90.00*	*90.00*	.....	.....	.....	.....
Pittsburgh	**50.80**	**53.20**	**62.75**	**55.00**	**60.85**	**62.50**	**76.25**	.....	.....	120.00	130.00	18.10	22.05
	69.00	*68.10*	*66.10*	*65.80*	*65.20*	*65.75*	*82.75*	*88.75*	*88.75*	.....	.....	.....	.....
St. Louis[‡c]	**61.00**	**61.00**	**57.00**	**56.00**	**57.00**	**59.00**	**71.00**	*75.00*	*75.00*	**87.00**	**87.00**	**14.60**	**17.80**
San Francisco[d]	[*Range from $32.00 to $36.00*]				*34.00*	*34.00*	*34.00*	*34.00*	*33.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*45.50a*	*45.50a*	*45.75a*	*45.75a*	*44.50a*	*44.50a*	*47.75a*	*47.75a*	*48.50a*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [6] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* Ranges from $80 to $97.50: *j* Average price. *k* August 1943 price. *l* September price; none later available.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ¼", $95.15; on ⅜", $104.85; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness A quality	B quality	EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
Atlanta	74%	75%	$0.15	
Baltimore	78%	79%	.15	
Birmingham	76%	76%	.105	
Boston	77%	78%	.15	
Chicago	77%	77%	.15	
Cincinnati	77–10%	77–10%	.15	Price of 60% Ammonia Gelatin in $0.01 per lb higher than 40%
Cleveland	77%	77%	.19	
Dallas	76%	76%	.1575	
Denver	76%	76%	.155*e*	
Detroit	77%	77%	.1575	
Kansas City	77–10%	77–10%	.155	
Los Angeles	86%*d*	88%*d*	.1575	
Minneapolis	77%	77%	.15	
Montreal	40–10–2%*ab*	50–2%*ac*	.1675†	
New Orleans	70%	75%	.16	
New York	80%	81%	.22*f*	
Philadelphia	78%	79%	.15	
Pittsburgh	79%	79%	.1225	
St. Louis	77–10%	77–10%	.155	
San Francisco	66%	73%	.155	
Seattle	75%	75%	.1575†	

a Discount from list Sept. 1939; sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1928.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less-congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal St. add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.105	$0.13	$0.15
W. of Miss. to Rocky Mtn. States, Fla. and Maine.	.11 –.1175	.135 –.1175	.155 –.1675
Rocky Mtn. States	.11 –.1225	.135 –.1525‡	.155 –.1725‡
Pacific N. W. States	.1075–.12	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1125	.135 –.1425	.155 –.1625

‡ F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES F.O.B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail — Pine *	By Rail — Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	.....
12 in.— 2 ft. from butt	6-in.	50 to 59-ft.	.35	.....
12-in.— 2 ft. from butt	6-in.	60 to 69-ft.	.36	.....
12-in.— 2 ft. from butt	6-in.	90 to 100-ft.	...	.54
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	...	.56
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.63
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.57
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	.....
14-in — 2-ft. from butt	5-in.	85 to 89-ft.	.57	.....
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	...	.62

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.50	....	$2.00	....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.43/1.54	2.59	1.76	2.86
	Mixed Oak	1.71	2.59	2.42	3.58
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.45/2.65*a*	....	3.35/3.60
Los Angeles	Douglas Fir	2.00	3.25*a*	2.90	4.70*a*
Philadelphia	Red Oak	....	2.10*ag*	....	3.25*ag*
St. Louis	White Oak	1.70	....	2.40	....
	Red Oak	1.63	2.15*a*	2.19	3.25*a*
	Sap Pine or Cypress	1.70	....	2.06	....
San Francisco	Douglas Fir	1.25*bcf*	....	....	3.00*caf*
Montreal	Birch or Maple	....	1.65	1.04	....

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6"x8"x8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* F.o.b. cars. † Out of market. *g* January 1943 price, none later available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.50– 3.10
Chlorine cylinders, liquid, per lb., delivered	.0525
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd, ton.	18.50–35.00
Silicate of soda, 52 deg. in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00–25.00
Sulphate of copper, in bbl., per 100-lb	5.00

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE PARTITION—SCORED Per M lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE—LOAD BEARING—SCORED Per M lots of 2,000 pieces or over 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M in quantity Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized, or lump
Atlanta	$110.00	$130.00	$230.00	$240.00	$270.00	$300.00	.....	$24.00	$17.50	$13.50	$15.04
Baltimore	90.00	95.00	175.00	200.00	260.00	300.00	17.00*k*	21.00*k*	20.00	15.00	2.50*m*
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	18.50	23.00	18.11	14.05	....
Boston	105.00†	112.00†	210.10†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	85.80	91.70	172.60	.....*x*	.....*x*	.....*x*	17.00	18.00	17.00	15.00	12.50
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	27.75	27.75	15.50	13.00	.....
Cleveland	98.10	104.56	.....*x*	.....	.....	.....	22.75	22.75	15.75	13.25	.....
Dallas	77.25	83.00	165.00	198.00	254.50	315.00	17.25	19.00	19.00	15.00	15.00
Denver	99.00	112.00	185.00	214.00	248.00	294.00	21.50	.....	30.00*j*	24.00*j*	26.00
Detroit	92.70	98.70	174.50	198.80	257.20	294.30	23.25*f*	23.25*f*	20.00	18.00	18.00
Kansas City	67.00	69.00	89.00*c*	128.00	163.00	189.00	16.00	18.50	19.32	13.00	10.92
Los Angeles	80.00†*r*	95.00†*r*	132.00*c*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	14.50	16.00	16.50	17.50	17.50
Minneapolis	.....	111.60*b*	186.25*b*	111.60	.....	.....	25.50	31.50*y*	24.00	16.00	19.00
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*a*	100.50*at*	134.50*av*	22.16†*u*	33.20†*u*	24.60*u*	15.00*u*	14.00*u*
New Orleans	104.50	109.55	207.25	222.25	326.90	385.65	17.75	.....	18.30	12.08	14.10
New York	99.40	106.00	145.75*c*	15.60*n*	.....	.....	19.50/20.50	.....	20.00	14.00	17.00
Philadelphia	112.10	119.60	224.20	2696.10	321.20	405.10	20.75	23.75	19.00	16.00	15.00
Pittsburgh	88.40	94.30	176.85	212.30	260.85	298.10	23.25	25.25*y*	17.90	15.40	2.55*m*
St Louis	67.00	72.00	130.00	190.00	244.00	290.00†	23.50	22.50	22.00	18.00	2.50*m*
San Francisco	96.00	108.00	144.00	108.00*t*	.....	.....	21.00	.....	18.50	18.50	1.85*m*
Seattle	115.00	125.00	230.00	125.00*t*	.....	.....	20.50*k*	24.00*k*	20.00*s*	20.00*s*	3.00*m*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6x12x12 in., 3-cell. *d* Not load bearing. *e* 48 lb. tile. *f* Includes $3.50 per M. for delivery. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* F.o.b. Warehouse only. *j* OPA Price. *k* $1.00 discount. *l* Lump. *m* Per bbl., 180 lb. *n* 7⅝ x 7⅝ x 12. *o* Per bbl., 200 lb. *p* 280 lb. bag. *r* 5% discount 10 days. *s* 2% discount for cash. *t* 5½ x 8 x 11½. *t* 5 x 8 x 12. *u* 8% sales tax included. *v* 6 x 12 x 12-in. *w* Per 200 lb. bag. *x* Not available. *y* Stacked

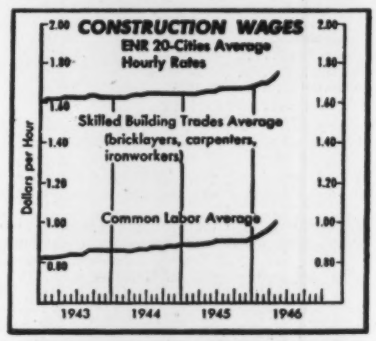
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	i Alumnum *b*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b., factory Rolls, slate surfaced, 85–90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl per ton
Atlanta	$10.25	$14.125	$1.30	$2.25	$1.20	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	10.00	13.75	2.00	3.00	2.50	2.30	2.70	2.70	.40	29.00
Birmingham	10.25	14.125	2.25	3.53	1.98	2.09	1.98	1.98	.32	28.35
Boston	10.00	13.75	1.75	2.50	2.31	2.00‡*h*	3.30‡*uv*	3.30‡*uv*	.25‡	21.00‡
Chicago	10.00	13.75	....	....	....	1.75*hf*	1.74*hf*	1.82*hf*	.33*f*	23.00*f*
Cincinnati	10.00	13.75	1.70	2.905	1.60	2.20	2.10*h*	2.10*h*	.33	25.00
Cleveland	10.00	13.75	1.70	2.90	1.60	1.71	1.63*h*	1.61*h*	.237	25.00
Dallas	10.00	14.50	1.88	2.11*n*	.05*l*	1.75*h*	1.66*h*	1.66*h*	.35	39.00
Denver	10.00	14.25	1.80	13.2*k*	16.15*k*	3.00	1.92*h*	1.92*h*	.29	29.00
Detroit	10.00	13.75	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	10.00	13.875	2.30*g*	2.55*g*	2.16*g*	2.19	2.30	2.30	.28	27.50
Los Angeles	10.25	14.25	1.60	2.25	2.30	2.10	1.50	....	45	.....
Minneapolis	10.00	13.875	....	....	....	1.7123*i*	1.6243*hi*	1.6243*hi*	.32	23.00
Montreal	.....	11.05	2.50*p*	4.90*p*	3.15*p*	2.71	2.45*t*	2.45*t*	.84*t*	1.83*kl*
New York	10.00	13.75	2.03	....	1.82	1.7098	1.6273*a*	1.6273*o*	.26	23.00
Philadelphia	10.00	13.75	1.60/1.80	2.20	1.55	2.25	2.71	2.71	.32	23.00
Pittsburgh	10.00	13.75	1.05	1.90	1.10	1.95	1.84*h*	1.84*h*	.34	26.00
St. Louis	10.00	13.75	2.28*s*	2.89*s*	1.96*s*	2.10	1.70	1.70	.45	23.00
San Francisco	10.25	14.00	1.80	2.75*n*	1.35	1.71	2.40	2.40	.33	20.50
Seattle	10.25	14.25	1.90	3.00	....	2.15	2.16*h*	....	.35	31.00*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3–49A. *c* ASTM Spec. D266–31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 55 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per 100 lb. *l* Per lb. *m* Per bbl. *n* May, 1941 price. *o* 60-lb. roll. *p* Plus 8% sales tax. *s* December, 1942 price. *t* Federal tax included. *u* 90-lb. roll. *v* Truck delivery.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.75	$1.50	$1.625	$1.50	$1.50	$0.65	$0.65
Baltimore	1.90	1.675	1.90	1.625/2.00	1.725	.95	.95
Birmingham	1.9375	1.375	1.625	1.50	1.65	.65	.65
Boston	1.725	1.60	1.725	1.65	1.667	1.15	1.15
Chicago	1.90	1.85	1.88	1.85	1.90	1.20	1.20
Cincinnati	1.875	1.65	1.775	1.875/2.125	1.875	.95	.95
Cleveland	2.00	1.65	2.00	2.00	2.00	1.25	1.25
Dallas	1.937	1.425	1.625	1.625	1.75	.70	.75 /1.25
Denver	1.80*b*	1.625	1.50*b*	1.625*b*	1.90	1.00	1.00
Detroit	1.90	1.625	1.825	1.675/1.825	1.775	1.15	1.15
Kansas City	1.75	1.575	1.70	1.70	1.75	.975	.90
Los Angeles	1.50	1.50	1.75	1.50	1.75	1.25	1.25
Minneapolis	1.825	1.50	1.75	1.60	1.725	1.01	1.01
New Orleans	1.625	1.375	1.625	1.55	1.50	.70	.80
New York	2.25*b*	2.10*b*	2.25	2.25*b*	2.00/2.25*b*	1.20	1.20
Philadelphia	2.00	1.58	1.90/2.00	2.25	2.00	.90	.90
Pittsburgh	2.00	1.75	1.75	1.8125	1.875	1.00	.90
St. Louis	2.00	1.70	1.90	2.20	1.90	1.00	1.00
San Francisco	2.05	1.75	1.75	1.60/2.00	2.00	1.0625	1.0625
Seattle	1.91	1.61	1.81	1.90	1.91	1.21	1.21
Montreal*	1.06	.96	1.01	1.01	1.06	.61	.66



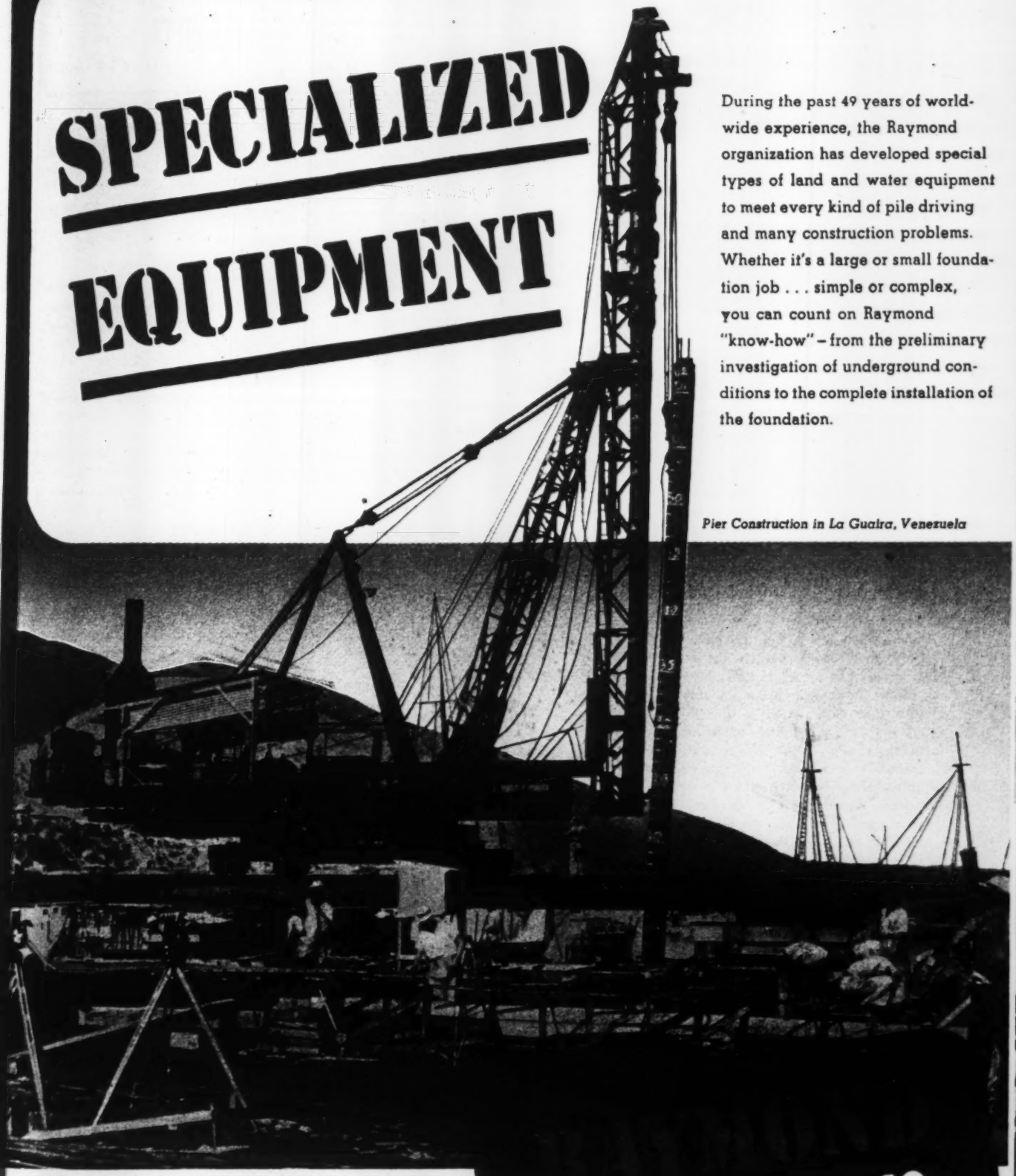
b 7 hr. day. * Cost of living bonus now included in basic wage.

ENR Skilled Average; (Bricklayers, Carpenters, Ironworkers) $1.762.

ENR Common Average; $1.004.

SPECIALIZED EQUIPMENT

During the past 49 years of world-wide experience, the Raymond organization has developed special types of land and water equipment to meet every kind of pile driving and many construction problems. Whether it's a large or small foundation job . . . simple or complex, you can count on Raymond "know-how" – from the preliminary investigation of underground conditions to the complete installation of the foundation.



Pier Construction in La Guaira, Venezuela

WE INVITE YOUR INQUIRY

THE SCOPE OF RAYMOND'S ACTIVITIES includes every recognized type of pile foundation – concrete, composite, precast, steel, pipe and wood. Also caissons, construction involving shore protection, ship building facilities, harbor and river improvements and borings for soil investigation.

"CONCRETE PILE CO.

Branch Offices in Principal Cities of United States and Latin America

140 CEDAR STREET, NEW YORK 6, N. Y.

New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Sensitized Papers

Positive prints may be made direct from engineering drawings and tracings without the use of a negative, it is claimed, with the new Weiline sensitized

papers. A dry-direct process of development, which uses no wet chemicals, quickly produces prints that are flat and true to scale.

Blue, red or sepia prints are obtainable with these new papers; this choice of color (blue or red lines on white background) permits quick recognition of prints from different departments, and differentiates checked from unchecked prints. Sepia prints on Weiline transparentized papers may be used as intermediate originals, to save the draftsman's time in retracing when making design changes. A special Weiline eradicator removes obsolete lines and new ones may be drawn in with pen or pencil.—*J. H. Weil & Co., 1315 Cherry, Philadelphia, Pa.*

• • •

Flexible Duct Material

Made of glass cloth and rubber, a new material, "Airtron," has high insulation and flexibility qualities as ducting for hot or cold air. This product, it is claimed, will withstand temperatures from minus 60 to 300 deg. F. without change in properties, and will stand well over 50 lb. psi. internal pressure; also it is unaffected by air, light, water, oils, and all but concentrated mineral acids.

"Airtron" is manufactured in tubes, of any desired length, 1 to 6 in. in diameter. It can also be made in specialized shapes.—*Arrowhead Rubber Co. 2244 E. 37th St., Los Angeles 11 Calif.*

New Electrodes

Several new electrodes have been developed, among them: Ni-Rod, for making machinable welds in cast iron; "133" 80-20 nickel-chromium electrode for welding the Inconel side of Inconel clad steel; and six other types for Monel, Inconel, nickel, "L" nickel, "K" Monel, 70-30 cupro-nickel and various clad steels.—*International Nickel Co., Bayonne, N. J.*

• • •

Pipe Line Strainer

A pressure and suction pipe line strainer maintains maximum liquid flow through piping systems while protecting pumps and moving parts which might be injured by foreign particles. Maximum

liquid flow is assured since the total area of the strainer basket perforations exceeds the area of the opening of the inlet by more than a 1:5 ratio.

On the cover of the unit is an air pressure relief valve that permits the escape of air that builds up within the unit and impedes the operation of the strainer and other pipeline mechanisms. The unit can also be furnished with a magnetized strainer basket for intercepting ferrous metal particles too small to be intercepted by the strainer.—*J. A. Zurn Mfg. Co., Erie, Penna.*

• • •

Street Lighting Control

A street lighting control device should help utilities companies to render street lighting service insuring required illumination regardless of fluctuations in weather conditions and the twilight hour. Principal components are standard amplifier tubes, a photo-electric cell and relay. The housing is of aluminum with high resistance to extreme weather conditions. The apparatus can also be used for control of lighting of public buildings, airports, outdoor advertising, etc.—*The Ripley Co., Torrington, Conn.*

• • •

Dust Collector

The centrifugal vortex principle characterizes a new dust collector, drawing dust through a flexible hose and hood into the interior of the cabinet, which contains a circular, conical shaped cyclone tank. Dust particles are forced to the center of the mass of spinning air and drop down into a removable dust receptacle; cleaned air floats out through the cabinet's fiberglas filter top and recirculates about the room.—*Leiman Bros., Inc., 115-80 Christie St., Newark 5, N. J.*

• • •

Protective Coating

A new form film prepares surfaces, such as plywood or other fibrous wood forms for concrete, so that the final surface is smooth and free from grain markings—ready to be painted if desired. Highly water-repellent, this product conditions the plywood and helps it to resist warping or swelling.—*A. C. Horn Co., 43-36 Tenth Street, Long Island City 1, N. Y.*

• • •

Lifting Bar

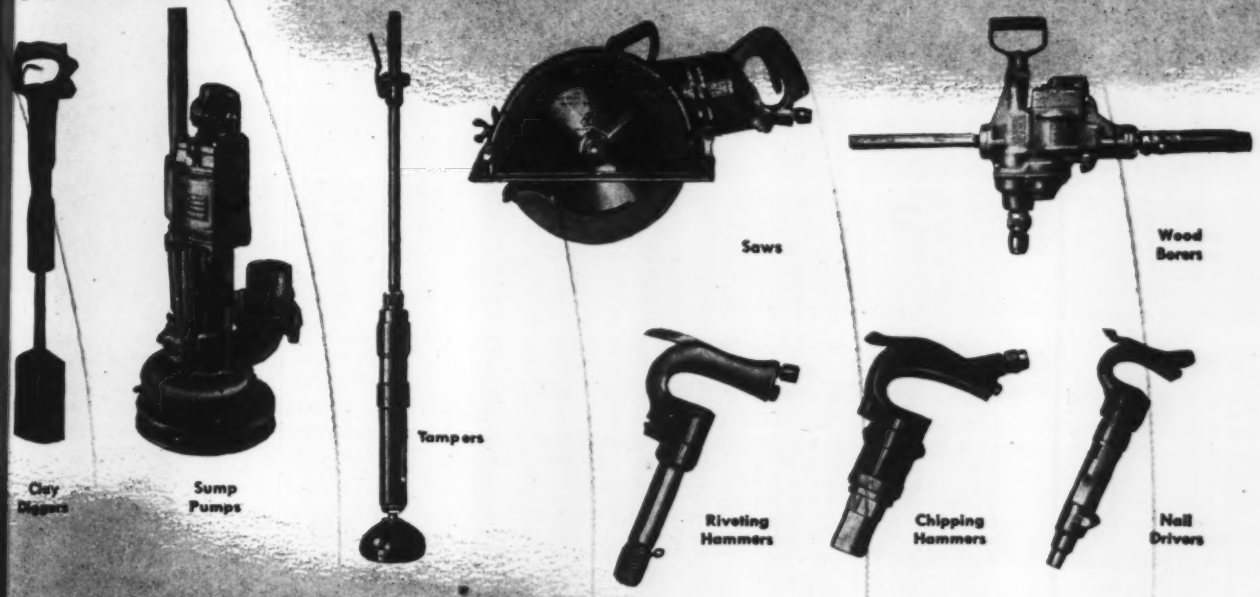
This lifting bar has a hardened steel roller for extra leverage and ledges for safe gripping. It can be furnished with any of three styles of interchangeable toe plates: (1) *notched* for prying up spikes and lag bolts and getting under heads and corners; (2) *straight-edged* for lifting and moving; and (3) *straight.*

(*Continued on page* 112)

NAME THE JOB...

will Name the Tools

TO DO IT FASTER, BETTER AND AT LOWER COST!



Bench Grinders

Leading contractors everywhere specify Thor Portable Power Tools to save time and cut costs. Favorites for more than fifty years, Thor tools have proved again and again their superiority in advanced design and rugged construction. Your nearby Thor Representative can help you choose just the right tools for your work from Thor's *complete* line.

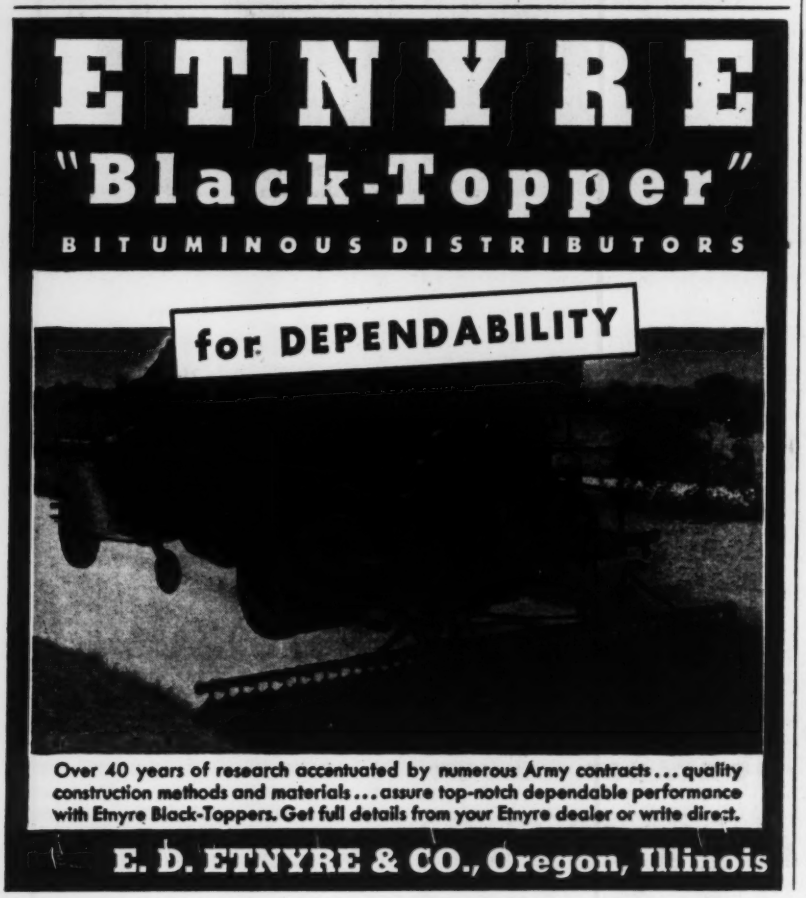
INDEPENDENT PNEUMATIC TOOL COMPANY
600 W. Jackson Boulevard, Chicago 6, Illinois
BIRMINGHAM BOSTON BUFFALO CLEVELAND DETROIT LOS ANGELES MILWAUKEE NEW YORK
PHILADELPHIA PITTSBURGH ST. LOUIS SALT LAKE CITY SAN FRANCISCO TORONTO, CANADA LONDON, ENGLAND

Thor

PORTABLE POWER TOOLS

PNEUMATIC TOOLS • UNIVERSAL AND HIGH FREQUENCY ELECTRIC TOOLS • MINING AND CONTRACTORS TOOLS

MEMO TO ALL CONSTRUCTION SUPTS.
For Bigger Payload Performance
...the logical first choice is HAISS HI-POWER. Unique for Sta-in-line reeving, out-of-the-muck sheaving. Weight placed for highest digging power, with closing ratios up to 7:1. Write for facts.
HAISS
HI-POWER
GEORGE HAISS MFG. CO., INC., 140th Street & Rider Ave., New York 51, N. Y.


ETNYRE
"Black-Topper"
BITUMINOUS DISTRIBUTORS
for DEPENDABILITY
Over 40 years of research accentuated by numerous Army contracts... quality construction methods and materials... assure top-notch dependable performance with Etnyre Black-Toppers. Get full details from your Etnyre dealer or write direct.
E. D. ETNYRE & CO., Oregon, Illinois

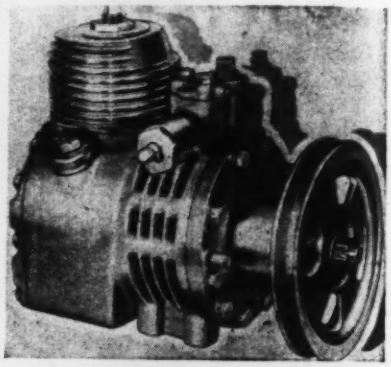
edged with rubber coating to prevent scratching enameled or finished surfaces. There are two sizes—5 ton and 1 ton capacity.

It is especially recommended for relocating machinery in plants, for moving or wrecking buildings, and for use wherever heavy objects must be lifted onto dollies or otherwise moved.—*Arnold Motor Co., 666 Lake Shore Drive, Chicago, Ill.*

• • •

Rotary Air Compressor

Recent improvements in a rotary air compressor include an oil filter with replaceable element; greater bearing capacity; larger air passages; accessible rotary shaft seal; exterior fins for air cooling and heat exchanger type endplate for water cooling; and an air pressure control valve an integral part of compressor.—*Wagner Electric Corp., 6400 Plymouth Avenue, St. Louis 14, Mo.*



• • •

Service Station on Wheels

Mounted on a truck or trailer, a new lubrication and repair outfit brings high-pressure lubrication and related services out to the job where fleets of trucks, construction machinery, and other equipment are operating. It is self-contained, with lubricant tanks, hose reels, compression pumps, tools and accessories built in.

An electric generating plant, mounted on the air compressor tank, furnishes current for lights and battery charging, and serves as a prime mover for the air compressor.—*D. W. Onan & Sons, 43 Royalston No., Minneapolis 5, Minn.*

• • •

Dragline Connecting Link

A link has been designed so that users are able to make their own repairs on links for dragline bucket assemblies. The links also are used to advantage in combination with chain or wire rope assemblies with hooks or other attachments. All connecting parts are in double shear, and are said to be stronger than the assemblies on which they are used.—*A. F. Wagner Iron Works, 1483 No. Water Street, Milwaukee 1, Wis.*

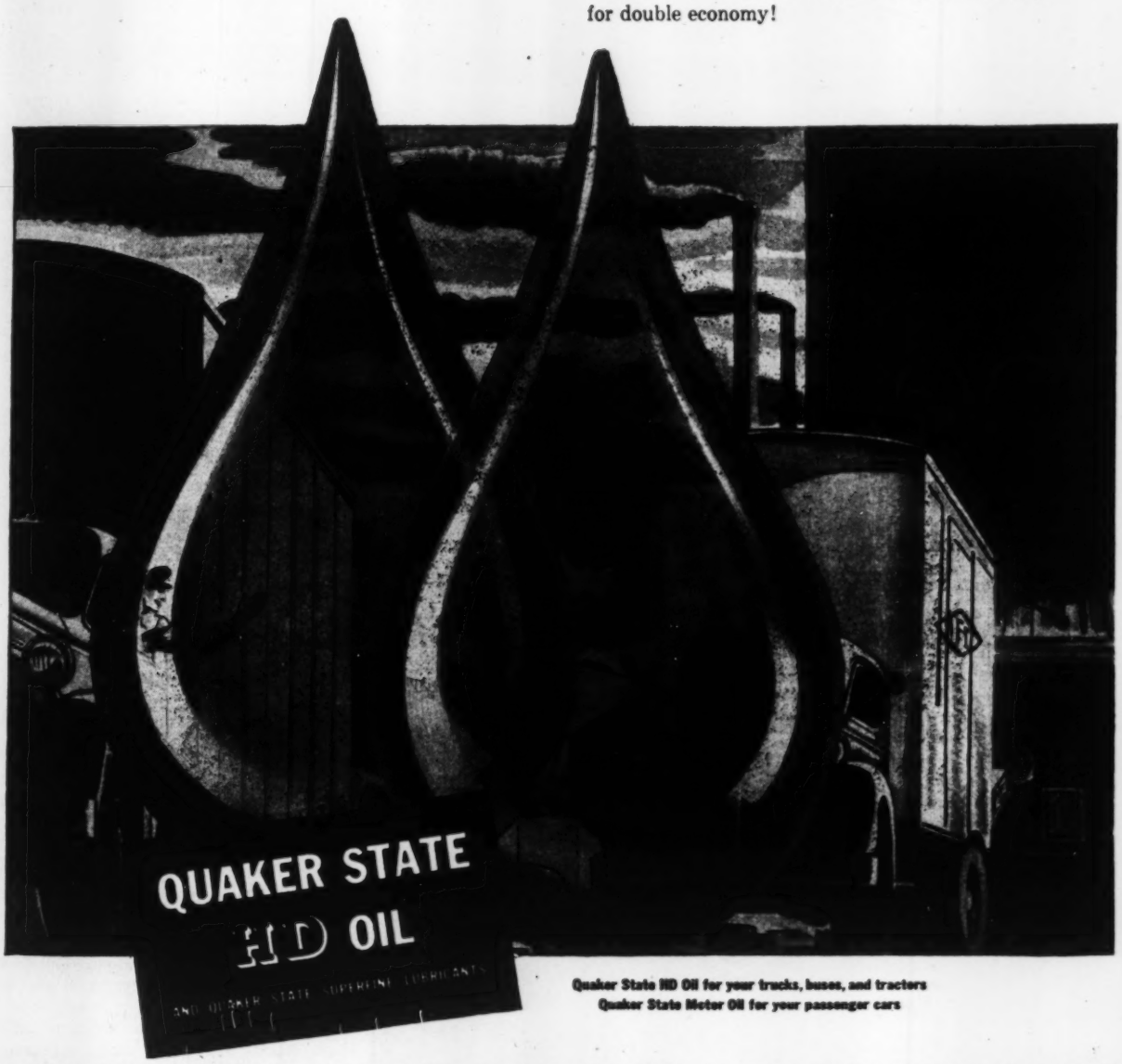
Now you have double reason for using DOUBLE-DUTY OIL!

AS millions of truck, bus, and tractor owners can testify, Quaker State HD Oil did DOUBLE DUTY in the engines of their equipment during the past four hard years — and they won't forget it.

They learned then that this DOUBLE-DUTY oil not only does lubricate better and longer, but keeps engines cleaner — loosens up and removes trouble-making dirt, sludge, grit, carbon, and gummy, sticky "varnish."

Today you have new equipment, or are planning to get it. You are going into a new period of keen competition, where costs must be counted. So Quaker State HD Oil can be doubly important to you now. Use it to help you protect your new equipment — keep it on the job, earning money — holding down costs.

Buy Quaker State HD Oil and use it regularly — for double economy!

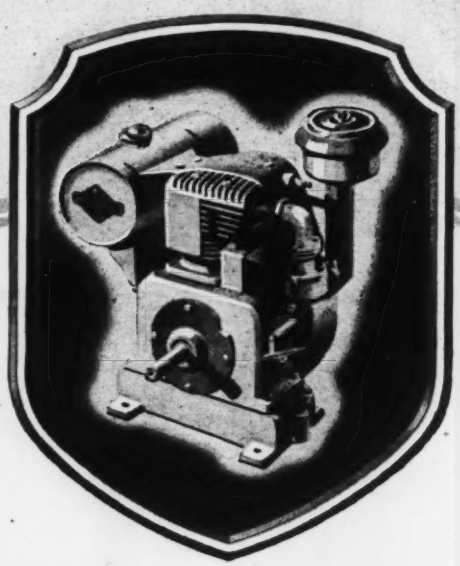


Quaker State HD Oil for your trucks, buses, and tractors
Quaker State Motor Oil for your passenger cars

QUAKER STATE OIL REFINING CORPORATION • OIL CITY, PENNSYLVANIA

BRIGGS & STRATTON ENGINES

As Always – Foremost in Value and Performance



LOOK with confidence to Briggs & Stratton 4-cycle, *Air-Cooled* engines—"preferred power" in all fields—for the latest and most advanced developments for every application requiring ⅔ to 6 H.P. Briggs & Stratton with its concentration of technical knowledge, modern plants, equipment, and skilled workers—builds gasoline engines which are more than equal to today's most exacting power and performance requirements. You can expect *and get* more value per dollar if the appliances, farm machines, or industrial equipment you buy, sell or make are powered by Briggs & Stratton.

BRIGGS & STRATTON CORP., Milwaukee 1, Wis., U.S.A.

Air-Cooled Power

4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

Manufacturers' Activities

E. R. GALVIN, formerly president of Tyson Bearing Corp., Massillon, Ohio, has been named executive vice-president, general sales manager and director of La-Plant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa. S. L. Myers, who has been vice-president and general sales manager during the last year, will become vice-president and export sales manager, while Jay M. Fetters, former export manager, will become manager of foreign development. At earlier periods Mr. Galvin was general sales manager of R. G. LeTourneau, Inc., Caterpillar Tractor Co., and the Cleveland Tractor Co.

KENNETH LINDSAY, vice-president and sales manager of the Iowa Manufacturing Co., has been appointed by Governor Blue to membership on the Iowa Development Commission. Mr. Lindsay's experience in every state of the Union qualifies him for the commission which was established for the purpose of using the natural resources of Iowa and increasing its industrial employment.

THE KOTAL CO. of New York, manufacturers of bituminous road paving material, has announced the appointment of the Charles Blum Advertising Corp. of Philadelphia, Pa., as its national advertising agent.

EMPLOYEES of the Macwhyte Co. recently celebrated the 50th anniversary of the incorporation of their company, at Kenosha, Wis.

MOTOR and machine manufacturers have been urged to join a movement to standardize sizes of ball and roller bearings. This standardization, asserted S. F. Wollman executive vice president of SKF Industries, Inc., would reduce costs, speed delivery of bearings, aid young industries, and broaden American participation in world reconstruction.

"Ball and roller bearing manufacturers are now required to produce and stock 40,000 sizes and makes of anti-friction bearings," Mr. Wollman said.

DRILL ROCK quicker, cheaper

with TIMKEN Rock Bits

Acclaimed by construction contractors and metal mine operators as the greatest rock drilling tool ever developed. An outstanding achievement of engineering experience; metallurgical knowledge; and steel making know-how; a highly specialized product manufactured in a completely-equipped modern plant where nothing else is made.

When we say that you can put down more holes in less time at lower cost with Timken Bits we are merely summarizing the experience of hundreds of contractors and mine operators who have standardized on these bits after proving their merits.

If you still are using conventional steels you don't know what you're losing; swing to Timken Bits and begin saving. Write for name of nearest Authorized Distributor. Look for the trade-mark "TIMKEN" on every bit you buy.

TIMKEN
TRADE MARK REG. U. S. PAT. OFF.
ROCK BITS

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

Worthington-Ransome Blue Brute Distributors

See ad on page 117 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Birmingham, J. D. Pittman Tractor Company
Ala., Montgomery, Burford-Toothaker Tractor Co.
Alaska, Anchorage, Airport Mach. & Storage Co.
Cal., L. A., Golden State Equip. Co.
Cal., San Francisco, Coast Equip. Co.
Colo., Denver, Power Equipment Company
Conn., New Haven, Wilhelm-Davies Co., Inc.
Fla., Miami, Allied Equip., Inc.
Fla., Orlando, Highway Equip. & Supply Company
Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida, Boise, Olson Manufacturing Company
Ill., Chicago, Chicago Construction Equipment Co.
Maine, Portland, Main Truck-Tractor Company
Mass., Allston, Boston, Clark-Wilcox Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Minn., Minneapolis, Phillippi-Murphy Equip. Co.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
Montana, Billings, Interstate Truck & Equip. Co.
Helena, Caird Eng. Works
N. M., Albuquerque, Bud Fisher Co.
N. Y., Albany, Milton-Hale Machinery Company
New York, Hodge & Hammond, Inc.
N. Y., Syracuse, Milton-Hale Mach. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.
Ohio, Cincinnati, Carroll Edwards Co.
Ohio, Dayton, Carroll Edwards Co.
Okla, Oklahoma City, Townsco Equip. Company
Oregon, Portland, Andrews Equip. Service.
S. D., Rapid City, Phillipi-Murphy Equip't. Co.
S. C., Columbia, Smith Equipment Company
S. D., Sioux Falls, Phillippi-Murphy Equip. Co.
Tenn., Knoxville, Dempster Bros., Inc.
Tennessee, Nashville, Dempster Bros., Inc.
Tex., Aramillo, T. W. Carpenter Equip. Co.
Texas, Dallas, Shaw Equip. Co.
Utah, Salt Lake City, J. K. Wheeler Mach. Co.
Vt., Barre, A. M. Flanders, Inc.
Wash., Spokane, Andrews Equip. Service
Wisc., Milwaukee, Drott Tractor & Equip. Co., Inc.

Ransome Distributors

Ariz., Phoenix, Lee Redman Company
D. C., Washington, M. A. Doetsch Mach. Company
Ill., Chicago, Thomas Hoist Company
Ind., Fort Wayne, American Steel Supply Corp.
Ky., Paducah, Henry A. Petter Supply Company
La., New Orleans, Ole K. Olson Company
Md., Baltimore, Stuart M. Christhilf & Company
Mich., Detroit, T. G Abrams
Mo., Kansas City, Brown-Strauss Corp.
Neb., Lincoln, Highway Equip. & Supply Co.
N. J., Newark, Johnson & Dealaman
N. C., Raleigh, Smith Equip. Company
O., Cleveland, H. B. Fuller Equip. Company
Pa., Philadelphia, Giles & Ransome
Wilkinsburg, Arrow Supply Company
Tex., El Paso, Mine and Smelter Supply Company
Houston, McCall Tractor & Equip. Company

Worthington Distributors

Ark., Fort Smith, R. A. Young & Son
Little Rock, R. A. Young & Son
Ind., Indianapolis, Reid-Holcomb Company
Ky., Harlan, Hall Equipment Sales Company
Louisville, Williams Tractor Company
La., New Orleans, Wm. F. Surgi Equip. Company
Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
Flint, Granaden-Hall & Company
Mo., Kansas City, Mach. & Supplies Co.
N. J., Hillside, P. A. Drobach
No. Bergen, American Air Compressor Corp.
N. M., Roswell, Smith Machinery Company
N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental & Sales
Olean, Freeborn Equip. Company.
N. C., Raleigh, Carolina Tractor & Equip. Co.
O., Cleveland, Gibson-Stewart Company
Toledo, The Kilcorse Mach. Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
Easton, Sears & Bowers
Harrisburg, American Equip. Corp.
Oil City, Freeborn Equipment Company
Philadelphia, Metalweld, Inc.
Pittsburgh, Atlas Equip. Corp.
Wilkes-Barre, Ensminger & Company
Tex., El Paso, Equip. Supply Company
San Antonio, Patten Machinery Company
Va., Richmond, Highway Mach. & Supply Co.
Wash., Seattle, Star Machinery Company
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

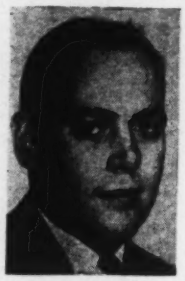
Blue Brute

Worthington Pump and Machinery Corp.
Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

"Some of these products differ from others by the merest hair's breadth. If a uniform system of basic sizes were adopted, it might be possible to concentrate on turning out about 2,000 sizes of bearings. These would meet almost every industrial need."

LE ROI Co., Milwaukee, Wis., announces the appointment of William Z. Bancroft as western district manager with headquarters at San Francisco.

Mr. Bancroft was graduated from the Colorado School of Mines at Golden, Colo., in 1936, where he specialized in fuel engineering. Following graduation and his reserve officer training, he was commissioned 2nd lieutenant and spent a year in the regular Army at Fort Logan, Colo., during which tour of duty his work involved general engineering with the Combat Engineers and practical field experience in the modernization of Fort Logan. For three and a half years following, Mr. Bancroft was associated with the Sullivan Machinery Co., and, early in 1941, was recalled to active duty in the Corps of Engineers, U. S. Army. After service in various field offices, he was advanced to executive officer to the director of Military Construction, Office of Chief of Engineers, Washington, D. C. He attained the rank of lt. colonel, and shortly before his retirement, was awarded the Legion of Merit for outstanding achievement and devotion to duty in the Engineer Corps.



W. Z. Bancroft

The company also announced appointment of Thomas V. Shea as eastern district manager with headquarters in New York City.

T. V. Shea

Mr. Shea is an honor graduate of the United States Naval Academy, 1933. While at Annapolis, he majored in mechanical engineering with emphasis on naval steam power plants, gasoline and diesel engines.

In 1934 Mr. Shea was graduated with a master's degree in mechanical engineering from the University of Wisconsin. He also completed one year at the Graduate School of Business Administration, Harvard University.

From 1939 to 1943 he was associated with the Phillips Petroleum Co., Chicago, as a sales engineer, specializing in liquified petroleum gases and their specific application to railroads, truck-lines, industrial plants, and utilities. In 1942 he became assistant manager for operations of Phillips Industrial Division, headquarters in Detroit.

In 1943, Mr. Shea became staff engineer and general supervisor of fuel systems and equipment for A. O. Smith Corp. in Milwaukee, Wis.

F. B. HORNIBROOK, an authority on concrete and concreting materials, has been appointed assistant director of research of The Master Builders Co., Cleveland, Ohio. On the staff of the National Bureau of Standards since 1930, Mr. Hornibrook served as assistant to the section chief of the cement and concreting materials section for the last five years. He was in charge of tests of concrete and concreting materials, curing materials and admixtures for consuming government agencies and for the Federal Trade Commission. Research projects under his direction included freezing and thawing studies of concrete, and materials and methods of application of chemical floor hardeners. Working under the direction of E. W. Scripture, Jr. director of research, Mr. Hornibrook will head the research laboratory and supervise research, control and field service.

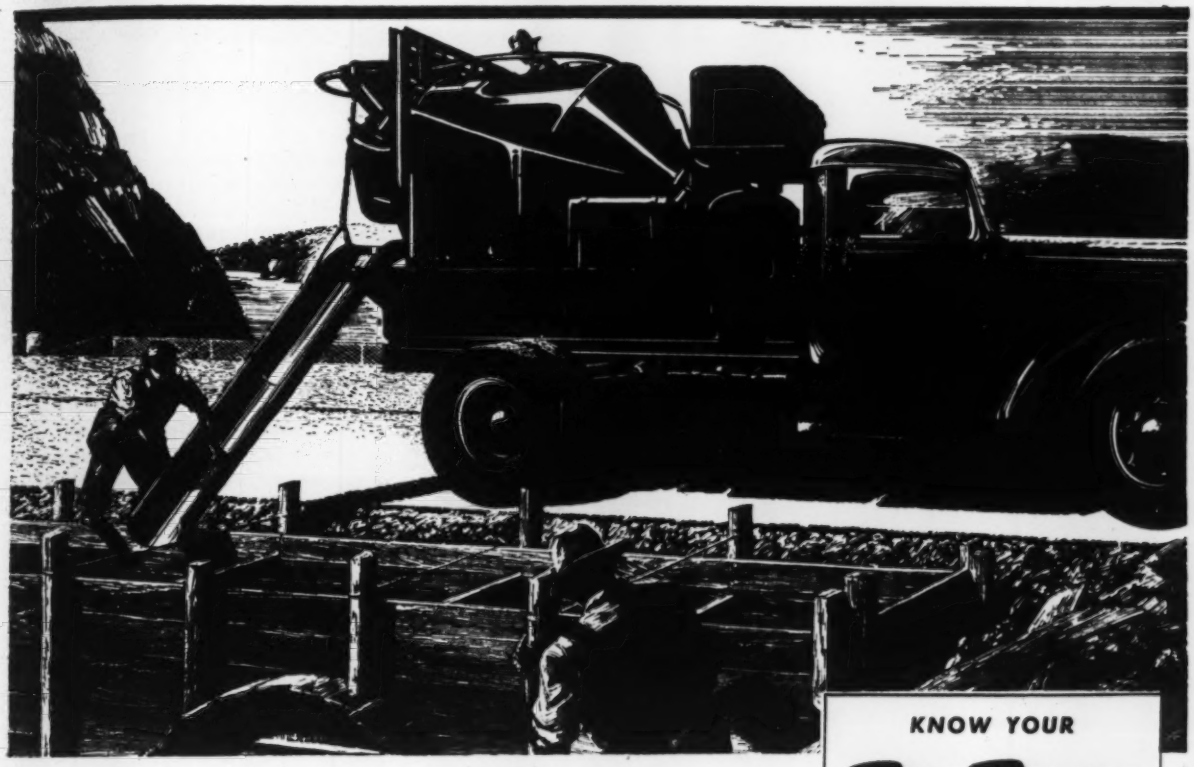
E. S. MCCORMICK, formerly lieutenant with the U. S. Navy Seabees, has been appointed district representative for the American Hoist & Derrick Co. at Chicago. Prior to entering the service Mr. McCormick was with American Hoist & Derrick at the home offices, St. Paul, Minn.

R. J. NYMBERG has been named sales manager of the hoist and body division of Gar Wood Industries, Inc., Detroit, Mich. Mr. Nymberg joined Gar Wood in 1921 as a body engineer, and was made sales engineer in 1932.

Henry Husbands has been named to assist Amos E. Heath, district manager of the company's general line in Washington, D. C.

Ross Miller, district manager—general

HI-UP... IN NAME, REPUTATION AND QUALITY



Flexibility, engineered into all Ransome Blue Brute Truck Mixers, reaches its peak in the new Hi-Up. This flexibility eliminates all strains resulting from misalignment while charging, discharging, or operating over uneven ground. The truck mixer is designed so that when discharging is completed, all moving parts return to their normal positions.

The transmission shows a marked advance over usual design. Enclosed water pump clutch requires no adjustment and at no time is there any need for manual lubrication. A separate engine clutch, two speeds forward and reverse, and multiple disc clutches assure easier starting, a wider performance range and smoother operation.

Other new design details: Unbreakable, anti-freeze gauge glasses, in full view of the operator . . . Quick-charging, unobstructed hopper, with improved sealing door, prevents jamming . . . Positively leak-proof poppet valves with renewable discs — found only in Ransome Truck Mixers . . . Exclusive mixing drum design, with new type spiral blades, for quick charging and fast, clean discharging.

These are but a few of the reasons why the Blue Brute Hi-Up is setting a new high in truck mixer performance — and offering time-saving, trouble-free production of better concrete at lower cost.

Get the whole story from your nearby Worthington-Ransome dealer, or write for Bulletin No. 221.

R6-7

KNOW YOUR

BLUE BRUTES

Your Blue Brute Distributor will gladly show you how Worthington-Ransome Blue Brute Hi-Up Truck Mixers and other construction equipment can put your planning on a profitable basis — and prove that *there's more worth in Worthington.* His name is listed on Page **116.** Blue Brutes include:

RANSOME EQUIPMENT

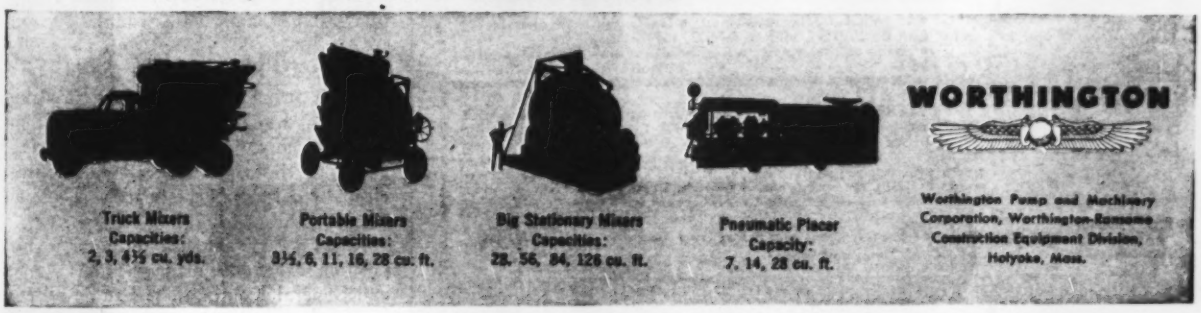
Pavers, Concrete Spreaders and Finishers*, Portable and Stationary Mixers, Pneumatic Placing Equipment, Truck Mixers, Plaster & Bituminous Mixers and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Contractors' Pumps* and Accessories.

*To be announced.

BUY BLUE BRUTES



5 FACTS PROVE

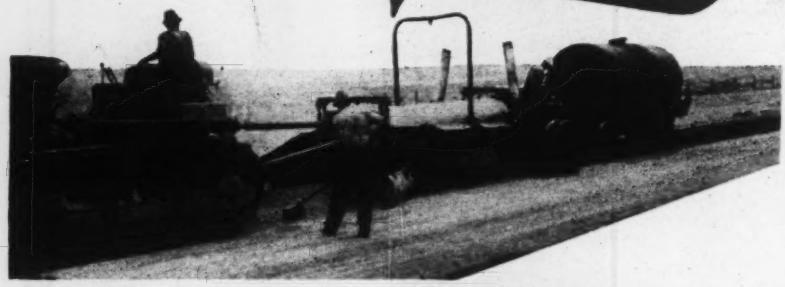
★ LOWER FIRST COST: When you buy a Wood Roadmixer you buy only one piece of equipment.

★ LOWER MAINTENANCE COST: Pulled and powered by a standard crawler tractor.

★ TWO-MAN OPERATED: One man on tractor, one man on Roadmixer for average job.

★ HANDLES ALL MATERIALS: Road oils, emulsions, asphalt, soil-cement, etc.

★ MAXIMUM PRODUCTION: Wood Roadmixer produces in excess of 250 tons an hour of ready-to-spread mix.



WOOD ROADMIXER...

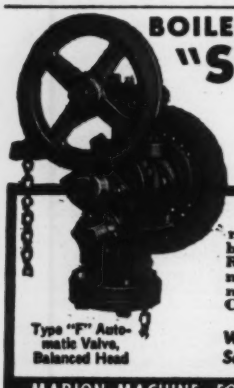
THE WORLD'S LEADING TRAVEL PLANT

Low-cost native or local materials located at or near the site of the job can be used for paving with a Wood Roadmixer. This saving in labor and equipment often cuts the original cost of a job as much as two-thirds under other methods.

The Wood Roadmixer is the world's pioneer and leading travel plant method of rapid, low-cost pavement construction. For literature and prices, see your Wood Roadmixer dealer or write direct. 2B

WOOD MANUFACTURING CO.

BOX 620, 6900 TUJUNGA AVENUE • NORTH HOLLYWOOD, CALIFORNIA



BOILERS "SNAP OUT OF IT!"

MARION SOOT BLOWERS

modernize boilers right now! They do this work:

- Increase boiler capacity and flexibility
- Save 5 to 10 percent on fuel bills
- Do the job mechanically and quickly
- Blow out soot deposits without injury to baffles

MARION SOOT BLOWERS eliminate stubborn soot with minimum waste of steam. Type "F" for water tube boilers blows in any length of arc from 15 to 345 degrees. "Keeps on Rollin' " to right or left as desired. Favorites with skilled engineers and power plant owners, MARION SOOT BLOWERS are made for all sizes and types of boilers. Parts are interchangeable. Continuous service with low replacement and repair costs.

Type "F" Automatic Valve, Balanced Head

Write for Specifications and Prices
Save Cost, Time, and Worry

MARION

MARION MACHINE, FOUNDRY AND SUPPLY CO. • MARION, INDIANA, U. S. A.

line, is acting temporarily as manager of Gar Wood's Philadelphia branch (hoist and body division), succeeding A. E. Hilderley, retired. Edward F. Kreutzfeld has been named service manager of the hoist and body division to succeed Mr. Miller. William F. Keeton has been placed in charge of the company's newly-created advertising department. Charles J. Hoffman has been placed in charge of the newly-formed export department.

CHARLES H. GANT has been appointed manager of Hercules Powder Co.'s Parlin, N. J., plant, succeeding Edward G. Crum who has been appointed assistant general manager of the cellulose products department of Hercules in Wilmington, Del.

An engineer at the Parlin plant during the first world war, Mr. Gant has served as plant manager at two Hercules-operated government explosives plants during World War II. From 1919 until 1942, he was secretary and manager of the Marine Terminal in Wilmington, Del. He re-joined Hercules in 1942 as manager of the New River Ordnance plant at Pulaski, Va., and was transferred the following year to Badger Ordnance Works, Baraboo, Wis., where he has served as manager until the present. He was graduated from Rutgers University with a B.S. degree in 1914, and a degree in civil engineering in 1923.

OSCAR D. NELSON recently was elected president of the Butler Mfg. Co., succeeding E. E. Norquist, one of the founders of the business. Mr. Nelson began with the company as an office boy.

PAUL LA FRANCE, recently a lieutenant commander in the U. S. Navy, has been assigned as sales engineer for the construction equipment division of Worthington Pump & Machinery Corp., with headquarters at Washington, D. C.

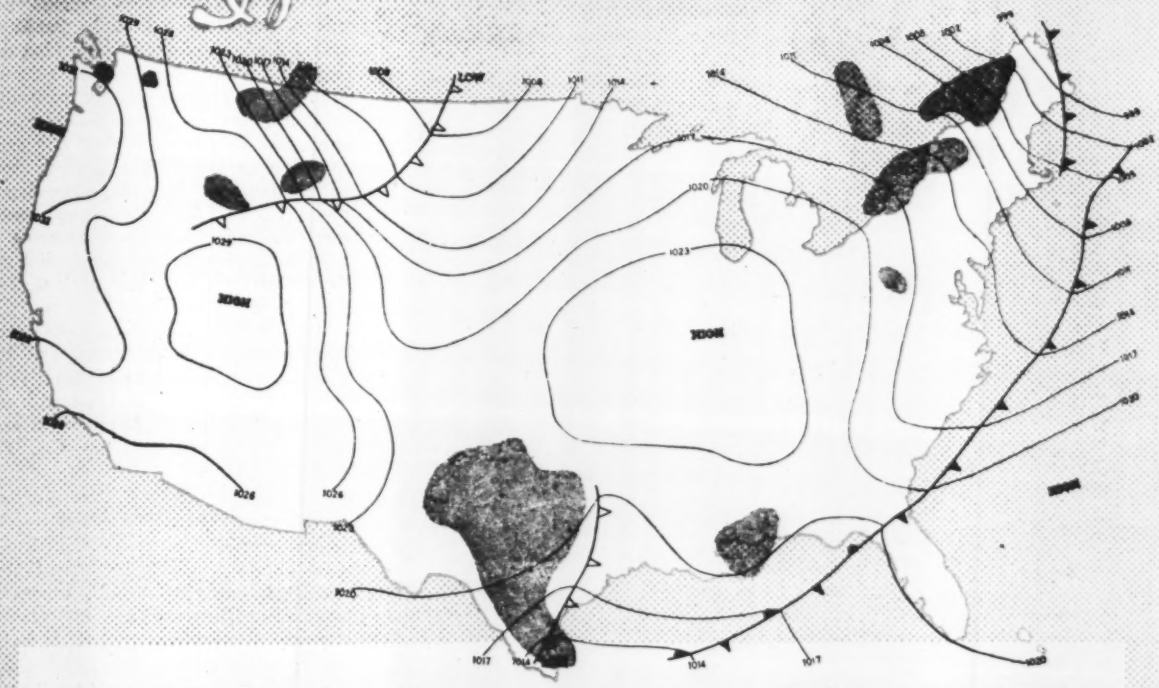
LIMA LOCOMOTIVE WORKS, Inc., shovel and crane division, has announced appointment of Paul Fenwick as district manager in the states of California, Arizona and Nevada.

PAUL A. SCHOELLKOPF, president of the Niagara Falls Power Co., has announced the appointment of Ralph E. Robida as general superintendent; and Charles A. Clancy as assistant.

JAMES H. KELLOGG, vice president of Kellogg Switchboard & Supply Co., Chicago, Ill., has been elected president of the company, succeeding his father, James G. Kellogg. Mr. Kellogg, Sr. was elected chairman of the board.

ROBERT NAYNARD has returned to his position as export manager for Osgood and General Excavator, to handle all ex-

TIREX Ignores WEATHER HAZARDS



On weather maps you will, at times, find temperatures ranging from -25° all the way to +120° and in many of these places with extreme temperatures you will find TIREX cables giving consistent, everyday, dependable service under all kinds of imaginable conditions. Regardless of whether it is summer heat or winter cold, TIREX cables stay on the job and give the kind of service you always want.

The conductors of TIREX cables are protected by the Selenium Rubber Armor to which a new feature has been added. This new feature is flame-resistance. It's an added safety feature and it makes TIREX just that much more valuable to you although the price has not been increased to take care of this extra service which TIREX cables offer to you.

All TIREX cables are today flame-resistant. The next time you need a portable cable be sure you specify and get Simplex-TIREX, the flame-resistant cable with the Selenium Rubber Armor.

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SIMPLEX WIRE & CABLE CO.
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IDEAL

for large dimension tracing sheets calling for extra long lines of unvarying width. Rectangular-shaped, HI-DENSITY Lead sharpens to a super-efficient chisel point that delivers longer lines between repointings. Test this exclusive EBERHARD FABER time-saver at any accredited "Van Dyke" Dealer.

Chisel Point Leads come in degrees: 6H, 4H, 2H, HB, 2B, 4B. Round Leads in 18 degrees from 9H to 7B.

port sales and advertising for the two lines. Mr. Maynard recently was discharged from the Navy after serving three years.

AMERICAN CHAIN & CABLE CO., INC. of Bridgeport, Conn., announces that Wilmot F. Wheeler has been elected president, succeeding the late William T. Morris. Mr. Wheeler has been with the company since 1916, was elected a director in 1919 and treasurer in 1920. He has been executive vice president and treasurer since 1936.

W. F. Wheeler

Cyrus F. Johns has been elected executive vice president. Mr. Johns joined the Page Steel and Wire Co. now a division of American Chain & Cable Co., Inc., in 1913, and was made general manager of that division in 1933. In 1937 he was elected a director of the company and in 1940 vice president in charge of operations of all plants.

C. F. Johns

Stanley Mann has been elected president. He has been a director of the company since 1936 and assistant treasurer since 1943. Mr. Mann was treasurer of Standard Chain Co. when it was acquired by American Chain & Cable Co., Inc. in 1917.

NEW OFFICERS and directors have been elected for the Clarostat Mfg. Co., Inc., Brooklyn, N. Y., following the retirement of the founders of the company. Victor Mucher is now president; George Mucher is chief engineer and vice president; William Mucher is treasurer; and Charles Burnell has become secretary.

JAMES C. BARNABY, consulting engineer for the Worthington Pump & Machinery Corp., has been transferred to the general engineering staff at the Harrison, N. J., Works as assistant director of research and development.

AMERICAN BRIDGE CO. has announced the appointment of Newton O. Holt as senior contracting manager for the Chicago district, succeeding Walter G. Zimmermann, retired.

THE PHILADELPHIA GEAR WORKS, INC., has recently appointed Leroy L. Handy, 6932 Cass Ave., Detroit, Mich., to represent the company in the Detroit area.

Manufacturers' Publications

Dredging Ladder—A 24-page book throws light on profitable sand and gravel dredging, including working deep deposits which cannot be efficiently dredged with plain suction pipe lines. It shows how a dredging ladder overcomes the difficulties of sand and gravel dredging by providing a positive means of continuously loosening the deposit, and by effectively preventing oversize material and refuse from entering the pipe line and pump.—*Eagle Iron Works, 129 Holcomb Ave., Des Moines, Iowa.*

Arc Welding Accessories—Everything for the weldor is described and illustrated in a folder. Many difficult to find items are properly identified with catalog numbers for simplification in ordering.—*The Hobart Brothers Co., Troy, Ohio.*

Shovels, Cranes, Draglines — This manufacturer recently published a 24-page catalog covering its line of 1½ to 2-cu. yd. capacity shovels, cranes and draglines. Illustrated are interesting examples of machines applied to a wide variety of excavating, steel erecting and material handling jobs.—*Link-Belt Speeder Corp., 301 West Pershing Road, Chicago 9, Ill.*

General Service Pumps—A new 20-page, 2-color catalog covers the design, construction, and engineering details of single-stage general service pumps suitable for a variety of services, including condenser circulation, air conditioning equipment, transfer service in sugar refineries, chemical plants, oil-tank farms, food-packaging plants and many other industrial hydraulic requirements.

These single-stage units are designed for capacities to 25,000 gpm, against heads up to 300 ft. They are available in several combinations of metals for a wide variety of liquids. A number of pages show typical installations; several others give cross-section and interior views; another presents the various types of drive available.—*Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.*

Speed Reducers—A 16-page bulletin contains useful engineering data of value in selecting the proper reducing unit for various needs. Fully illustrated, it shows installations in movable bridges, ferry lifts, gates and dams.—*The Earle Gear and Machine Co.*, 4707 *Stenton Avenue, Philadelphia* 44, *Pa.*

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LAY WATER PIPE FASTER
when it's easy-to-handle Transite

KEEPING UP with the trenching machine is common practice when the pipe being installed is Transite!

Crews can unload and install this easy-to-handle, asbestos-cement pipe quickly . . . lay all but the larger sizes without mechanical handling equipment. The Simplex Coupling cuts assembly time . . . assures tight, yet flexible joints.

And in addition, Transite delivers these *long-term* advantages:

No tuberculation. Made of asbestos and cement, its initial high flow rate (C=140) is unaffected by tuberculation. Users never have to contend with excessive pumping costs resulting from this costly form of internal corrosion.

High corrosion resistance—outside, as well as inside and all the way through! Thousands of Transite Pipe installations—many in highly aggressive soils—testify to its exceptional resistance to soil corrosion.

Low maintenance. Transite's tight joints, high uniform strength, great durability and proved corrosion resistance all add up to low maintenance. Over the years, Transite Pipe has established an enviable record for economy in water distribution and supply lines throughout the country.

For complete information, write for brochure TR-11A. Johns-Manville, Box 290, New York 16, New York.

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TRANSITE PRESSURE PIPE
An Asbestos Product

Tunneling

through a mountain?

Line it with

WOLMANIZED LUMBER*

Seepage is the bane of all tunnel makers. Moisture plays havoc with untreated lumber linings. Tunnel engineers, like mining men, have found that it pays to build with Wolmanized Lumber.

Why? Because with Wolmanized Lumber you get deep penetration of Wolman Salts* preservative . . . driven into the wood by the vacuum-pressure method in closed steel retorts. This lumber adds many years of service life to the project.

Whatever your needs—

AMERICAN LUMBER GIVES YOU ALL 3

1. **Wolmanized Lumber — protects against decay and termite attack.**
2. **Lumber treated with Minalith* fire-retardant is flameproof.**
3. **Creosoted lumber.**

*Registered trademarks

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Elections and Activities

G. A. Austin, Decatur, Ga., president of the Consolidated Quarries Corp., and treasurer of the Associated Industries of Georgia, has been elected president of the National Crushed Stone Association.

In addition to being head of the national organization which includes the principal producers of crushed stone, agricultural limestone, in the United States and Canada, Mr. Austin is also a member of the advisory council of the Associated Industries of Georgia, first vice-president of the Dekalb County Chamber of Agriculture and Commerce and a director of the Atlanta Freight Bureau.

C. T. Morrisett, construction examiner for the Federal Housing Administration, recently was elected president of the Capital chapter, Illinois Society of Engineers. Other officers are: S. J. Sibley, vice-president; R. S. Nelle, secretary-treasurer.

Jacob E. Warnock, senior hydraulic engineer for the U. S. Bureau of Reclamation, at Denver, has been elected president of the Colorado section of the American Society of Civil Engineers. Other officers elected include: Russell W. James, vice-president, and Alfred J. Ryan, secretary. C. Vernon Adkins was named junior assistant to the president.

Charles Valiguette, civil engineer and general manager of the Provincial Construction Co., Ltd., Montreal, Que., has been elected president of the Quebec Road Builders Association.

The Central Branch, Associated General Contractors of America, recently changed its official name to Associated General Contractors of Iowa.

Fred W. Shappert, Jr., of Belvidere, recently was elected president of the Illinois Contractors Association. Other officers: James F. Keeley, East St. Louis, vice president; Thomas H. Joyce, Jr., Springfield, treasurer.

Ted C. Jacobsen, Salt Lake City contractor, has been elected president of the Intermountain branch of the American Associated General Contractors. Other

11 "CATERPILLAR" DIESELS WORK HERE

E. H. Kerr, plant superintendent, minces no words in expressing his opinion of "Caterpillar" Diesels: "Best Diesel I ever had. Never had any trouble — never missed a day, even when running day and night. Wouldn't trade for any other make."

Ten engines and one 'dozer-equipped tractor make this a 100 per cent "Caterpillar" Diesel-powered limestone-crushing plant near Bloomington, Ind. A number of the engines have reached working records of more than 10,000 hours. Which some operators might consider a reasonable service life for a power unit under the tortures of grit and dust.

But "Caterpillar" Diesels are virtually youngsters at that age. They have the most thorough protection against grit and dust any Diesel engine ever had. Modern, "Caterpillar"-designed dust seals, and oil, fuel and air filters, guard every possible entrance to the wearing surfaces inside these "super"-efficient power-plants. This, plus all-round ruggedness, makes "Caterpillar" Diesels the ideal power for crushers and gravel plants.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CATERPILLAR *DIESEL ENGINES*

REG. U.S. PAT. OFF.

TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

The discharged veteran wears this emblem. Remember his service and honor him.

Portrait of a Dependable Chemical Feeder

DESCRIPTION:

%Proportioneers% Automatic and Proportional Hydraulically Operated Chem-O-Feeders are used for gravity or other water supplies where the rate of flow may vary from minute to minute. These units inject hypochlorite or other solution in proportion to main flow and are operated by water power from the main itself, or can be furnished to operate by compressed air, steam, etc. The Chem-O-Feeder has a double diaphragm and is of the Treet-O-Control type with pilot valve and gear box mounted on the meter, the feeding unit being separate and only connected to the pilot valve by copper tubing. This means that at any time you can add one or more Chem-O-Feeders for feeding chemicals—such as aqua ammonia for chloramine treatment, aluminum sulphate, soda ash, etc., by merely connecting the new units to the operating control lines without duplicating gear box, pilot valve and control meter. All Treet-O-Control meters are furnished with register to measure total through put of water.

SPECIFICATION:

Standard, double diaphragm 4D2-5D3 units are for line pressures varying from 10 up to 100 lbs. max. per sq. in. Special low pressure units are available for pressures from 4 up to 15 lbs. max. per sq. in. Chemical delivery is adjustable while unit is operating by means of micrometer stroke length setting, from 0 to approximately 12 CC per stroke. Maximum capacity depends on maximum allowable stroking rate which for hydraulic operation is usually 30 strokes per minute. At 26 strokes per minute, 12 CC per stroke, delivery is approximately 5 gal. per hour or 11.2 lbs. chlorine per day using 1% calcium or sodium hypochlorite solution.

Write for Bulletin SAN-1

% PROPORTIONEERS, INC.%

92 CODDING STREET,

PROVIDENCE 1, RHODE ISLAND

BOOTH NO. 7 MAY 6-10 AMERICAN WATER WORKS ASSOCIATION CONFERENCE

officers: Grant Thorne, Springville, vice president and J. H. Tempest, Sr., Salt Lake City, secretary-treasurer.

James Reid of Lewiston, Idaho, has been elected president of the Idaho Society of Engineers. L. E. Stalker of Idaho Falls is vice president; Archie Biladeau of Boise, treasurer and W. P. Eaton of Boise, secretary.

H. E. Modrow, recently was elected president of the Springfield, Ill. Engineers' Club.

Jack Eakin, Fremont, Ohio, has been elected president of the Sandusky-Ottawa-Seneca County Society of Professional Engineers.

C. S. Heidel, of Helena, Mont., hydraulic engineer for the U. S. Geological Survey, was elected president of the Montana section of the American Society of Civil Engineers at a recent organization meeting. Other officers are: David M. MacAlpine of Bozeman, and George F. Sahinen of Helena, vice presidents, and R. H. Willcomb of Helena, secretary-treasurer.

Charles W. Shirey, of Waterloo, Iowa, was elected president of the National Ready-Mix Concrete Association at the group's annual convention at Cincinnati, Ohio.

The Toledo Section of the American Society of Civil Engineers has elected Carleton S. Finkbeiner as president.

Ben M. Hogan of Little Rock, Ark., was elected president of the Arkansas Association of General Contractors at a recent annual meeting in Little Rock.

At the annual meeting of the Association of Professional Engineers of New Brunswick, Canada, the election resulted in G. M. Brown, St. John, being named to the presidency. J. H. Morrison, of Campbellton, is vice president.

Alan J. Potter was recently elected president of the Associated General Contractors of Massachusetts, at Boston.

The Mississippi Society of Professional Engineers recently elected A. B. Hargis, Mississippi University professor of engineering, as president. R. L. Morrison, Hattiesburg, was nominated for president for 1947.

U. W. Battershill, Winnipeg, has been elected president of the Manitoba Association of Professional Engineers.

G. Ross Lord, associate professor of mechanical engineering, University of Toronto, was elected president of the Association of Professional Engineers of Ontario recently. George B. Langford was elected vice president and W. H. M. Laughlin and V. S. Murray councillors representing the civil engineering branch of the association.

The Fort Wayne, Ind., Associated Building Contractors have elected officers as follows: Gregory A. Lauer, president, succeeding Norbert J. Schenkel; Clarence L. Schust, first vice-president; William Cupp, second vice-president; Albert Weinman, treasurer; and J. J. Werstein, executive secretary.

The Colorado Section of the American Society of Civil Engineers, has given life memberships to J. L. Brownlee, B. G. Coy, M. C. Hinderlider, C. H. Howell, A. N. Miller and F. W. Whiteside.

The New York Metropolitan Chapter of the American Association of Engineers recently installed new officers. President is George Williams; Charles J. Moody, 1st vice president; Arthur Richards, 2nd vice president; Eugene T. Lake, secretary, and Robert H. Place, treasurer.

Members of the Eastern States Conservation Conference, holding their first meeting since 1943 at Boston recently, heard an address by H. J. Kropper, chief, engineering division, U. S. E. D., Providence, R. I.

Officers for the County Superintendents and City Engineers of Highway District No. 5, Illinois, are: President; Fred Carl, Sullivan, Moultrie County superintendent of highways; vice-president, John Kearns, Champaign city engineer; William C. Gaffney, district engineer of county roads and city streets, Paris.

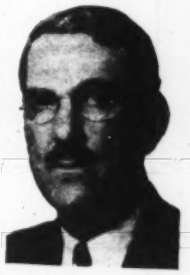
The various engineering and technical societies of Milwaukee, Wis., joined activities to provide a central meeting place in the new home of the Engineers Society of Milwaukee in what formerly was a palatial family residence located on the city's west side.

This arrangement has been made possible by the backing of Milwaukee industry in large part, some 100 companies having contributed upwards of $100,000 for the purchase of the home and for about $75,000 worth of renovations.

Local chapters of a number of national societies have a contract arrangement to share the use of the new engineer's society building free for meetings. They include the American Institute of Electrical Engineers, American Society of Mechanical Engineers, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, American Society of Refrigeration Engineers, American Society of Civil Engineers and the newly organizing Institute of Radio Engineers.

Men and Jobs

Ernest H. Harvey retired as city engineer of Newton, Mass., recently at the age of 71. He has been succeeded by **Willard S. Pratt,** a graduate of Northeastern University, who has been assistant engineer for the last 17 years. Mr. Harvey had served in the Newton engineering department for 56 years. When he retired Mayor Paul M. Goddard said to him, "You have always commanded the respect and admiration of your associates in the city government."



John W. Oehmann, for the last 22 years inspector of buildings and director of inspection for the District of Columbia, retired March 1. He will open a consulting office in Washington to specialize in the design, supervision and inspection of buildings during construction, and also in building code practice. Mr. Oehmann entered the service of the district government in 1909 as engineer and inspector in the engineering department and in 1924, was appointed inspector of buildings. In 1944 he was made director of inspection.

Mr. Oehmann served overseas in World War I as captain in the Field Artillery, with the 1st Army Corps, and in World War II as colonel with the engineers, commanding the 346th Engineers in England. He was retired Feb. 16, 1944, as brigadier general in the District of Columbia National Guard. He is a charter member of the Society of American Military Engineers and a past president of its Washington post. Mr. Oehmann is also a life member and a past president of the Building Officials Conference of America.

V. E. Thierman, city engineer of Swift Current, Sask., has resigned to go to the W. C. Wells Construction Co., Ltd., in Saskatoon.

S. F. Borg and **B. J. Kaganov** have announced the formation of the consulting engineering firm of Borg, Kaganov and Associates, specializing in civil aeronautical engineering structures and flight test-

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Consider these vital facts: Over 950 new corporations last year. New modern State Constitution. Low taxes. Unlimited water supply. Wealth of raw material and abundance of firm power. Vast pools of skilled native-born friendly labor. Rich diversified consumer market. Hub of all inland transportation. Extensive cultural and educational facilities. 350 alert communities eager and able to offer every cooperation.

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5. Adjustable Capacity
6. Indicates, Records, Integrates
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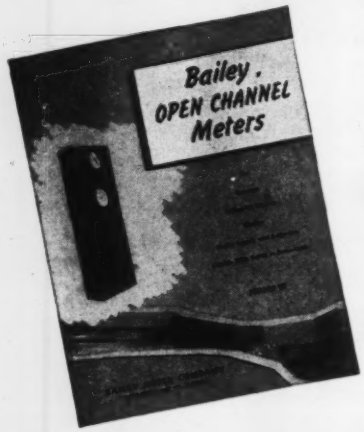

SEWAGE

INDUSTRIAL WASTES

SLUDGE

IRRIGATION WATER

Ask For Bulletin 62

MU23

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SOIL AND ROCK EXPLORATION

MacARTHUR CONCRETE PILE CORPORATION

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CINCINNATI • NEW ORLEANS

ing. Mr. Kaganov was formerly chief structures and flight test engineer of Eastern Aircraft and Mr. Borg was assistant professor of civil engineering at the University of Maryland. Offices will be in Annapolis, Md., and New York City.

A number of employees having more than 25 years of service with the Oregon highway commission in administrative positions will receve special awards from the American Association of State Highway Officials. They include **R. H. Baldock,** state highway engineer; **C. B. McCullough,** assistant highway engineer; **Samuel H. Probbert,** office engineer; **Ethan A. Collier,** maintenance engineer; **Glen S. Paxson,** bridge engineer; **Howard G. Smith,** construction engineer; **W. E. Chandler, K. D. Lytle, Paul Van Scoy** and **W. C. Williams,** division engineers at Bend, Roseburg, La Grande and Portland, respectively; and **F. T. Young,** assistant division engineer at Portland.

James T. Reside is now a captain in the Navy's Bureau of Yards and Docks, where he is acting head of the Fleet and Industrial Facilities Division. Reside headed the Dry Docking Facilities section during the war and was directly responsible for the great floating and graving dry-dock program carried out by the Navy. For his accomplishments he was given a citation as Honorary Officer of the Most Excellent Order of the British Empire and was commended by the Secretary of the Navy.

Captain Reside, a graduate of Lafayette in Civil Engineering, has been with the Navy's Bureau of Yards and Docks since 1916, but served as a civilian until 1942.

A. M. Reid, Grande Prairie, Alta., government district engineer, has been transferred to Edmonton. **Capt. F. B. Connors** of Calgary, Royal Canadian Engineers, succeeds Mr. Reid.

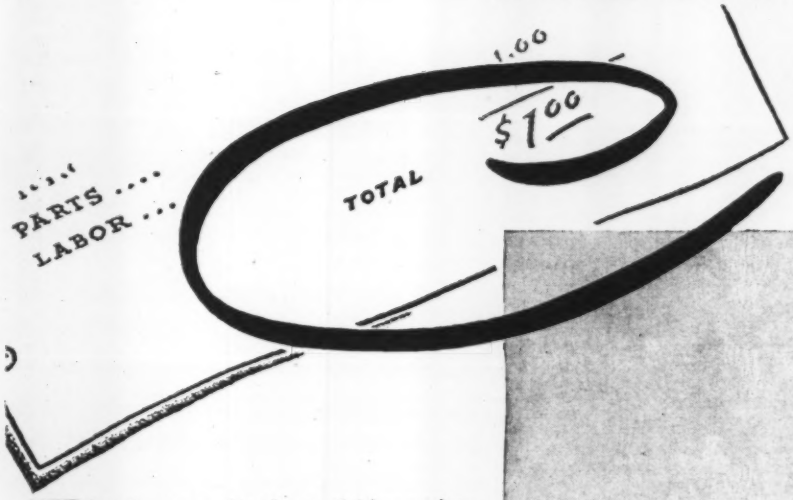
Robert E. Copper has been named chief engineer for the Peoria and Pekin Union Railway Co. to succeed **E. H. Thornberry,** retired. Copper has been acting chief engineer.

William Eric Griffiths, divisional engineer, Ottawa, Ont., has been promoted to division engineer, Montreal Terminals and St. Jerome Division, Quebec, Canadian National Railways. **Gordon Locklin Plow,** formerly assistant divisional engineer, Quebec, has been appointed divisional engineer at Ottawa.

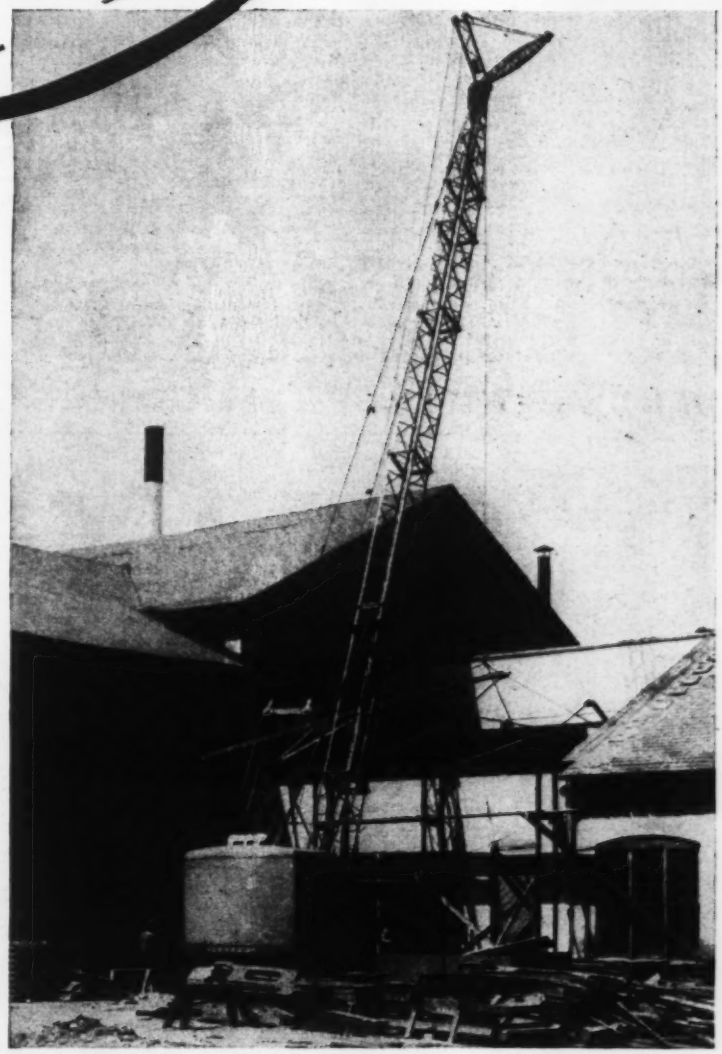
98% OF ALL THE GENERALS EVER BUILT ARE STILL IN ACTIVE SERVICE!

22,000 HOURS OF OPERATION---

TOTAL COST OF REPAIRS



$1.00



There's a record to shoot at! A heavy duty ¾-yard GENERAL, owned by Mr. J. R. Savage, prominent Ohio construction man, operated an average of 20 hours a day for 3½ years, working alternately as pull shovel, clamshell, dragline and crane, and during that time the total cost of repairs to the unit was exactly ONE DOLLAR! That's keeping service costs at rock bottom!

And don't forget, this amazing record was compiled on all types of work . . . Mr. Savage keeps his equipment busy on every kind of job. This GENERAL took all the jobs, even the toughest ones, in stride. Right now, this unit is busy on a $750,000 project Mr. Savage has started for the Wheeling Steel Corporation.

Low-cost, efficient performance like this means lower bids, more work, greater profit. The record proves that General-built equipment will deliver cost-cutting performance, time and again. Remember, 98% OF ALL THE GENERALS EVER BUILT ARE STILL IN ACTIVE SERVICE. That's a factor worth considering when you're planning to purchase new equipment. Better get complete details on the new line of GENERALS soon to be available . . . it's the first step to greater profits!

THE OSGOOD COMPANY
SHOVELS, DRAGLINES
CRANES
CRAWLER & WHEEL MOUNTS
DIESEL, OIL, GAS, ELECTRIC

Associated with The Osgood Company

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CRANES-SHOVELS MARION GENERAL OSGOOD
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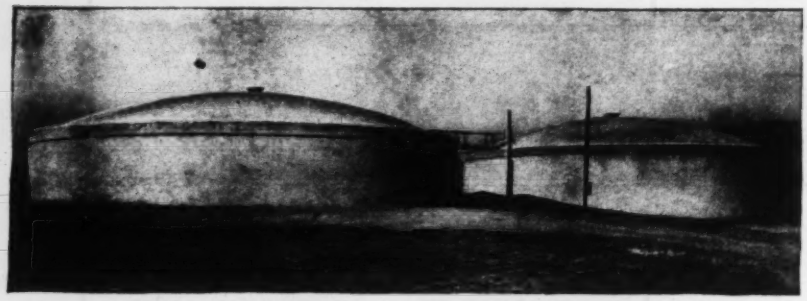
GENERAL
CRANES, DRAGLINES
AND SHOVELS
DIESEL, GAS, ELECTRIC

CEMENT GUN COMPANY

"GUNITE" CONTRACTORS

GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



PRE-STRESSED "GUNITE" TANKS

Above are shown two 80' diameter 750,000 gallon prestressed "GUNITE" water storage tanks with "GUNITE" dome roofs. We built these tanks in 1943 for the Borough of Schuylkill Haven, Penna.

Prestressed "GUNITE" produces a water storage tank which is bottle tight and maintenance free. They may be built either at ground level, completely underground with earth covering over the dome roof, or may be in the form of stand-pipes or elevated tanks.

Our experience in this field includes scores of tanks and silos of many types ranging up to two and one-half million gallons capacity.

Our 72 page Bulletin A2300 describes this method of construction fully and also other uses of "GUNITE."

Write for your free copy of Bulletin A2300 today.

MANUFACTURERS OF THE CEMENT GUN

BROWNHOIST BUCKETS

Designed and built by Industrial Brownhoist Corp. do a better job because, 1) Large Sheaves reduce rope wear, 2) Heavy Carbon - Steel digging lips take deep, clean bites, 3) Extra-sturdy construction insures long life. Write for complete facts to Industrial Brownhoist Corporation, Bay City, Michigan. Offices in New York, Philadelphia Cleveland and Chicago.

BROWNHOIST BUILDS BETTER BUCKETS

To civilian activity

Thomas R. Archibald, colonel, Corp of Engineers, construction engineer for the Board of Education, Rochester, N. Y., has returned to civilian duties after three years of service.

Grant P. Gordon, major and chief of the engineering division of the Seattle district, U. S. Army Engineers, has returned to the Bureau of Reclamation, and has been assigned to Northwest regional headquarters at Boise, Idaho.

E. Burton Hughes, major, has been appointed assistant director of the bureau of rights of way and claims in the N. Y. State Department of Public Works.

W. K. Dickson, colonel, has reopened an engineering office at Charlotte, N. C. He served as director of supply at Fort Bragg, N. C., until 1944 when he went overseas.

John W. Grant, major, Corps of Engineers, is now back at his former position with the Cutler-Magner Co., Duluth, Minn.

M. P. Boulden, recently promoted to colonel, has returned to his former position of engineer of design, district 9, Carbondale, under the Illinois Division of Highways.

Fred Davidson, major, Corps of Engineers, formerly with the Illinois Division of Highways, district 9, Carbondale, will teach at the Missouri School of Mines, Rolla, Mo.

Harold F. Gerold, of Sandusky, veteran of both world wars, has been made division engineer of Division 3 of the Ohio State Highway Department.

Fred Curl, lieutenant colonel, succeeds Troy Tim as city engineer of Sullivan, Ill.

Stuart M. Weaver, colonel, Corps of Engineers, has become executive vice-president of the Ideal Electric & Mfg. Co., of Mansfield, Ohio. Prior to entering the Army in 1942, he was superintendent of the water department and executive assistant to the town commissioners of Montclair, N. J.

Peter C. Karalekas, major, Sanitary Corps, on Feb. 14 was appointed chief engineer of the municipal waterworks, Springfield, Mass. His latest assignment had been as chief sanitary engineer in Honduras for the Division of Health and Sanitation of the Institute of Inter-American Affairs.

William A. McWilliams, lieutenant colonel, has been appointed assistant chief engineer of the State Highway Department of Delaware, with which he had been connected for nearly 25 years. He had service in Germany with the VII Corps. He was provost marshal of Nancy and Metz after hostilities ceased.